AUSTRALIAN INTERNATIONAL DEVELOPMENT ASSISTANCE BUREAU

FORESTRY DIVISION

MINISTRY OF NATURAL RESOURCES

SOLOMON ISLANDS NATIONAL FOREST RESOURCES INVENTORY

PROJECT WORKING PAPER NUMBER 6

FOREST RESOURCES INFORMATION SYSTEM:
DESIGN AND APPLICATION

W.K. Mayr, W.P. Thompson and R.W. Fenwick

ACIL AUSTRALIA PTY LTD

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EXECUTIVE SUMMARY

This report reviews user requirements and design specifications for the Forest Resources Information System (FRIS) for the Solomon Islands. The proposed design differs from the original proposal, although the fundamental structure remains unchanged. The changes from the design document arose from an analysis of user requirements and the need for the system to accommodate the range of data required for environmental analyses.

The concept behind the establishment of FRIS is that an inventory of forest resources is needed to ensure that the utilisation of the forest resources is sustainable.

Utilisation of the forest resource occurs at various levels: the most obvious, and those which contribute substantially to export income are commercial logging and sawmilling. However, cash cropping and subsistence farming are also significant consumers of the forest resource with possibly 70000 ha being cleared in the next 20 years for agricultural purposes. With only an estimated 380000 ha of forests below 400m worthy of detailed inventory, this represents some 20% of the resource. Foraging in the forest resource for food and other essentials is also an important form of forest utilisation. Forests also provide clear water for villagers.

The forest resource makes a most important contribution to the stability of SI landscapes and ecosystems. Degradation of the forest resource that leads to increased sedimentation and erosion could degrade the main coastal and in-shore environments on which the fisheries sector depends.

These potential uses of forest resources suggest a set of potential users for FRIS and the key data attributes that the system must contain. Initially the Ministry of Natural Resources through its Forestry, Environment and Conservation, and Fisheries Divisions will be the main user of FRIS followed by the Ministry of Agriculture and Lands through its Survey and Lands and Agriculture Divisions. Secondary users will include such diverse groups as the Government Statistics Office, Meteorological Service, Ministry of Health and Medical Services, the Herbarium etc. Usually these groups will need access to FRIS to obtain their own data in a collated and well presented form. The data that they provide to FRIS is required by others for forest sector planning.

The private sector is not seen as a direct user of FRIS. The data held by the logging companies and non government agencies is either not available in a usable format or is of restricted relevance and utility to FRIS. These groups

generally use the plans and assessments prepared by the main users of FRIS. Access to FRIS by the private sector should be via the public sector agencies, otherwise FRIS should be designed as a public information system.

The FRIS itself is not intended to compile resource utilisation plans. However, the design must have provision to hold the results of such plans once they have been compiled. For this reason the design includes the facility to hold as maps and data, the necessary information to compile watershed and environmental sensitivity classifications for SI.

FRIS is designed to ensure that data is accessed at a level consistent its reliability. This is achieved by restricting the scales at which users can "view" data to scales consistent with the accuracy of the data.

FRIS data is divided into primary and supporting data. The primary data group contains the key resource information from the forest inventory, terrain classification, land systems and land tenure. This data is accessed using the design concept of Resource Map Units developed in PNG and currently used in Vanuatu. The supporting data will contain information that is not directly related to natural resource boundaries, or is more general in its spatial relevance than the specific Forest Resource Units (FRU) which comprise the primary group. Data on census, climate, logging licences, etc will be held as supporting data. This hybrid approach of adopting a "FRU layer" which can be queried in conjunction with other data layers is seen as the most elegant method of fully utilising the power of available GIS technology.

"Computer literacy" in SI is quite high. DBASE and LOTUS are widely used in the various departments. During the Inception Phase, data in LOTUS and DBASE formats were available from the Government Statistics Office (Census), Environment and Conservation Division (fauna collection records), Meteorological Service (climate data), Agricultural Research (Socio Economic Surveys covering forest utilisation for agriculture), Herbarium (lists of species by common names, localities and traditional uses).

Selected data from these sources were loaded into the prototype FRIS developed for the pilot area. As well, several of the staff assigned to the project have either a background in computing or are able to process data in DBASE and LOTUS. These staff were able to enter data from the pilot area with minimal supervision. This data entry will continue into 1991, including the gap between the Inception and Implementation Phases. This may require extra supervisory visits by the data base specialist over the period March to May, especially if the start of the implementation phase is delayed.

The computer software used in the prototype FRIS falls into two categories. The data base system (FOXPRO) is fully compatible with the line agencies' expertise as it is DBASE compatible. The spatial or mapping software (MAPINFO) is not in use in SI, but installation is planned in Vanuatu and Papua New Guinea (PNG) and it is widely used as resource information software in Australia.

The introduction of this software will require three initiatives on the part of the project: the customisation of MAPINFO through its in-built program control facilities (termed MAPCODE) to meet the specific needs of FRIS operators; commitment by the project to train SIG personnel in the use of the system; and comprehensive training of the SIG data base manager in all the operational aspects of the software.

Sufficient data was obtained during Inception Phase to allow the data base specialist to make a significant start on the first two of these objectives prior to, or early in, the implementation phase. All training should be conducted in country during the first year of the project.

SIG commitments to the project will involve staff from the Survey and Cartography Division (SCD) and the Forestry Division (FD). Staff from SCD will be drawn from the Photogrammetry and Cartography Sections, these sections having considerable expertise. Two staff members will be required on a full time basis, their main duty is digitising maps, ultimately they should be trained to operate the system.

One FD staff member will be involved full time in the entry of field data and database manipulation. One person, designated the Data Base Manager will be given training so he has a solid understanding of information system management. Both positions should be given similar but less intense training on aspects of map digitising to the SCD staff. A third person will be required to enter data from the environmental field survey which will generate a similar volume of data to the Forest Field Survey.

Institutional aspects of FRIS require careful consideration. The SCD in the Ministry of Agriculture and Lands is responsible for providing cartographic and photogrammetric support to the FD of the Ministry of Natural Resources. To do this it maintains a paper based database of maps, plans and survey data. The SCD will provide the majority of the cartographic and photogrammetry expertise to the project as well as contributing the map base.

The Agriculture Division will also provide significant data and will become major users when planning begins. It is therefore recommended that FRIS managers be drawn from both Ministries, and that a technical working group be established with members drawn from the managers of each of the Divisions involved in the project on a day to day basis.

Budgetary provision is required for additional computer hardware, software, consumables and for upgrading the computer accommodation facilities at FD. This amounts to about AUD$60,000.

CHAPTER 1

INTRODUCTION

1.1 RATIONALE

The forest resource of the Solomon Islands is the pivotal natural resource of the nation. Forest utilisation through the subsistence slash and burn farming system, food and fibre foraging and fauna hunting is a major factor in the way of life adopted by the agrarian based society of the Solomon Islands. A brief review of the demands on the forest resources from the smallholder farming sector is given in Annex 1, where a preliminary assessment indicates that an additional 70,000 ha of forest will be converted to farming over the next 20 years. Commercial logging contributes significantly to the national economy. The balancing of these two forms of utilisation is required to reduce conflicts and ensure that degradation or over exploitation of the forest and associated land resources does not endanger the other major natural resource of the Solomon Islands - the coastal and near coastal resources that are vital to the fishing and tourism industries.

A Forest Resource Information System (FRIS) must therefore take account of these factors in the information it holds.

While forest utilisation determines the broad parameters of the data that the FRIS will hold, it is important to recognise that any resource information system does not, in itself, result in more efficient use, greater conservation or sustained use of those resources. Information systems, whether computerised or not, are merely tools for the storage of, and access to, data by the users. Information systems should ensure that resource information is used efficiently and within the limits its reliability. FRIS can not generate forest utilisation or environmental plans, however, it will allow those plans to be constructed far more efficiently and store the results of such planning as additional data resources.

1.2 STRUCTURE

Chapter 2 of this working paper identifies potential users and uses of the FRIS. A conceptual structure for the information system which ensures that data are held and accessible in a manner consistent with data reliability is outlined in chapter 3. This is followed by a review of available data, including data to be collected in the Implementation Phase.

Based on the information presented in chapters 2,3 and 4, chapter 5 defines the facilities that must be provided by the FRIS to meet user requirements. This forms the conceptual base for the more detailed system design of chapter 6.

Finally chapters 7,8 and 9 cover aspects of the Implementation of the system such as personnel, resources, institutional considerations, hardware and software requirements as well as costs.

The annexes are referred to throughout the text for readers looking for greater detail on selected topics.

For descriptions of technical terms used refer to annex 8, the glossary and guide to acronyms.

Throughout this working paper reference is made to the pilot area study (subject of a separate working paper 9 and annex 5). The data that it generated was incorporated into the prototype FRIS. This working paper draws from the pilot area study but is also based on the information available for the whole nation.

1.3 CONTRIBUTIONS

This paper was written by three of the specialist SOLFRIP team and reflects their areas of specialisation, they are: the Resource Information Coordinator (RIC), Mr Bill Thompson; the Geographic Information System Specialist (GISS), Mr Walter Mayr; and the Database Specialist (DS), Mr Robert Fenwick.

Major contributions were made to the success of the prototype FRIS and its application to the pilot study by: Mr Nabura Te'Ka'ai (Surveyor General), Mr Elison Suri (SCD) and Mr George Scott (SCD) who provided support and facilities for the members of the team who worked in the SCD offices; Mr Gilmour Pio (SCD) who was trained in the use of MAPINFO and subsequently digitised all of the map data of the prototype FRIS; Mrs Margaret Salini (FD) who entered the FFS data into DBASE.

CHAPTER 2

DATA USE AND USERS

2.1 INTRODUCTION

The key considerations in the design and operation of an information system are the user requirements and the data needed to meet those requirements. This chapter summarises the results of the preliminary user analysis. Subsequent chapters summarise the structure of the proposed data base, the data to be held in it, the entry and processing of data once it is collected and the programming required to commission the system.

2.2 USER REQUIREMENTS

2.2.1 User Requirements Analysis

User requirements were assessed in two ways. Separate discussions between the potential users and the Resource Information Coordinator (RIC) and Geographic Information Systems Specialist (GISS) were held during the period mid November to late December. A series of workshops was held for user groupings where the developing prototype using MAPINFO and DBASE software was demonstrated and participants were encouraged to comment on the system. These workshops were particularly valuable as data provided by various individuals and groups as a result of the earlier discussions were incorporated into the FRIS and demonstrated at each workshop.

The discussions showed that the level of computer literacy and the familiarity with both spreadsheet and DBASE applications is already quite high amongst most potential users. A surprising amount of data is already in DBASE format (DBASE III), most of the remainder is in LOTUS 123 spreadsheets, while some other data sets were still in formats that could be readily computerised.

Even allowing for the relatively high level of computer literacy, the conduct of the user requirements survey in the absence of even a prototype system is fraught with problems. In computing industry terms, the concept of an attribute driven spatial information system as proposed in this project, is neither complex nor does it involve a high level of technology. However, spatial information (for example maps of village locations, forest maps) and their related attributes (census data, forest inventory site data) is traditionally held in disparate agencies in the Solomon Islands, as is the case in many other countries.

In many cases the "collectors" and users of the raw attribute data are institutionally or technically removed from the "map makers". The concept of a combined spatial and attribute information system is thus a new concept. Users are therefore unlikely to be able to articulate what they would want from the system in the absence of a working prototype. The workshops were designed to introduce the technology and then develop a prototype to facilitate interaction amongst the users with data provided by them.

The workshops were divided into three broad groups:

(i) Technology Introduction:

These were conducted in late November for staff from the Survey and Cartography Division (SCD). At this stage the hardware and software had been installed and the requirement was to demonstrate the functional aspects of the system to staff who would be involved in digitising data. SCD staff already have a very high level of competence in cartography and photogrammetry, these workshops served to familiarise the staff with the types of procedures that are involved in computerising maps. An assistant photogrammetrist was assigned by SCD to work with the SOLFRIP team and assisted in the conduct of the remaining workshops. In December the SCD staff were given further informal demonstrations of the system as data was progressively captured by their colleague.

SCD involvement with FRIS is more likely to be as a provider of data rather than as a user. The major benefit perceived by SCD staff was the capability of the FRIS to automate the process of map production and customisation. SCD staff were also involved in the later workshops.

(ii) Forest Inventory Workshops:

A demonstration of the forest inventory applications of FRIS was given to the Project Coordination Committee (PCC) meeting in mid December and a workshop was held for the Forest Field Survey (FFS) field teams in early December. These workshops were based directly on the data collected by the FFS teams in November and December. The prototype at that stage contained data from the field plots, forest type mapping, census information, land systems and slope categories.

Similar reactions were obtained from participants of all of these workshops. Concerns were expressed that data accuracy was important, and that key information on volume estimations was available both on screen and as printed output. Whilst FRIS cannot in itself improve the accuracy of field inventory measurements, procedures will be incorporated to check and validate the air photo interpretation (API) of forest type units against individual field plots. Following these workshops, the GISS, in association with the FIS completed the checking of the data in the prototype. Significantly, this checking demonstrated the critical importance of field data sheet and API checking prior to entry to the FRIS. The ability of the system to "tag" data according to source greatly assists in this process (eg all plot data contains an attribute indicating who actually obtained the data in the field).

The requirement to integrate forest type and volume data with information important to forest utilisation was also raised. The need to identify areas as inaccessible on terrain criteria was emphasised, as was the usefulness of data on roads, tracks and villages. These issues are developed further in later sections of this working paper.

(ii) Non Forest User Workshops:

A single demonstration for staff from SICHE (Honiara and School of Natural Resources) followed an approach from SICHE. As SICHE is the main computer training group in SI and also includes the various level forestry courses at the SNR, they have expressed considerable interest in being kept informed of the progress of the project and the development of FRIS. The natural resource data covering Land Systems, Forest Resources and the sociological data base to be accumulated, was of particular interest, as the School of Natural Resources has a Physical Planning course.

A larger workshop involving staff from the Government Statistics Office (GSO), the Land Use Planning and Research groups from Ministry of Agriculture and Lands, Herbarium, Forestry and Geology Divisions from the Ministry of Natural Resources and the Ministry of Health and Medical Services was held in late December. Whereas the previous workshops concentrated on either the forest inventory or agricultural aspects of the FRIS, this workshop concentrated on the broader application of the data to be held in the system.

Interest was extremely high and results from this workshop indicate that the users will have a variety of requirements from the system. The combined spatial and attribute aspects of the FRIS are particularly important to groups such as the GSO and the Ministry of Health and Medical Services. Geographical tagging of floral distribution versus other land resource data is of interest to the Herbarium and agricultural researchers. Agricultural Research, Land Use Planning and GSO have indicated a desire to have access to the system when planning such activities as village surveys, extension programs and commercial agriculture development. The capacity to provide a combined land resource, forestry and climatic output in the form of maps and tabular summaries was identified as a key user requirement.

A concern raised by the non forest users was the question of access to FRIS, this is discussed below.

2.2.2 Classification of Users

Users of the FRIS can be broadly described in terms of their data input and output requirements, and the extent to which the raw data provided must be manipulated prior to entry into the system. A detailed review of data types is given in Chapter 4 with recommendations for how this data should be handled.

PRIMARY USER GROUP

The primary user group comprises those agencies which are responsible, at a technical level, for the management of the main resources or affected by utilisation of the forest resource.

Forestry Division

The Forestry Division of the Ministry of Natural Resources requires the system to hold both raw site data from field surveys and thematic or descriptive data on the classification of forests. Much of this data will be collected from the API and FFS components of this study. In addition, there is a requirement to hold forest control data such as logging licences which are the critical primary data that summarise commercial forestry utilisation. Ultimately, however, the proposed Timber Control Unit may well require additional data, either as input or output. It is therefore important that the FRIS structure remain sufficiently open ended to allow this to be easily accomplished. FD also requires data on merchantable forests to be displayed in conjunction with infrastructure data to assist better plan harvesting operations. Such data cannot be provided by the FD and must come from other sources. Finally, FD requires the site and area specific data on forest types and volumes to be extrapolated to the local level, probably to the provincial, and ultimately to the national level.

Environment and Conservation Division

The requirements of the Environment and Conservation Division of the Ministry of Natural Resources (ECD) are to identify current accessions of data on fauna and flora to guide future surveys; to map the location of rare and endangered species; and to correlate the current knowledge regarding ecosystems with potential distribution of similar ecosystems throughout the nation. Better bio-geographic distribution data will guide ECD in developing a national conservation strategy.

Agriculture Division

The Agriculture Division of the Ministry of Agriculture and Lands (MAL) makes routine use of Hansell and Wall's (1976) Land Systems (LS) as a non computerised agricultural resources information system. The later work of Chase (1981) on Crop/Land Suitability is, in effect, a planning tool linked to the LS. Both are widely used and represent particularly fine examples of their genre. (Refer to Annex 3 for a detailed discussion of Land Systems). The former would prove difficult to computerise as much of the information is descriptive. The latter, however, is formatted in its published form and is suitable for computerisation. Those Sections in MAL that are responsible for the development of commercial cash cropping (eg. Land Use Planning), have priority for additional information on the Agricultural Opportunity Areas (AOA) defined by Hansell and Wall. Those groups involved with research and extension activities, have a particular need for data relevant to the subsistence farming systems - primarily the utilisation of the forest resource by foraging and hunting/gathering.

The Agriculture Division is likely to be the second most frequent user of FRIS after the Forestry Division.

Fisheries

The Fisheries Division of the Ministry of Natural Resources (MNR) is a particularly important potential user. However, unlike Agriculture, no national level inventory of the fishing resource exists. Even infrastructural and hydrographic data are not readily available. This latter data is considered important, as knowledge of the main navigable in-shore waters and rivers is an important infrastructural component of the present export logging industry. However, fisheries represent a sector that could benefit directly from the FRIS, as the FFS and aerial photography and satellite imagery interpretation activities will result in the identification of the main coastal and estuarine habitats of potential importance to the fishing sector (mangroves, littoral shore lines, sea grass beds, etc)

Miscellaneous Users Group

This group of users has a lower order of priority for use and access to the system. In general, they either hold or collect data of secondary importance to the data base requirements of the major users. They would benefit from the system only in that they are able to more readily access their own data correlated with resource data of specific interest to them. For example the GSO has expressed interest in using the system to better plan rural surveys. The census data correlated spatially with forestry and agricultural land use data would be their main output requirement. In general high quality map products are also a high priority.

Lands Division

The Lands Division (LD) of the MAL is unlikely to be a major user of the system as the FRIS will not be structured to fulfil land administration requirements. Through SCD, LD has provided base maps showing alienated land areas and this data will be built into the system. The software in use for the cadastral data is widely used for these purposes elsewhere.

Government Statistics Office (GSO)

This division holds all of the census data for the nation. The data is computerised, but village, ward and enumerator maps are not. GSO have expressed a keen interest in providing the data and accessing the resulting computerised maps correlated to resource data.

Ministry of Health and Medical Services

The Ministry possesses a range of data. The malaria control program contains data on roads and communications not readily available elsewhere which may be of use to the planning of the field program. Village water supply information is also available. Their requirement of the system is not clear, although access to the computerised records of the Census and associated map outputs could be important.

Provincial Government, Provincial Development

This group can be expected to access the data base through the primary user agencies listed above. The data is important to realise regional or industry plans. The technical agencies will use this information to advise these planning agencies.

Herbarium, Ministry of Natural Resources

The Herbarium would potentially benefit from the system by using it to hold data on the geographical location of species. Whilst the forest inventory will not be a botanical survey, the potential exists for the herbarium to gain some benefit from the data base as a collection of specimens will be carried out during the FFS.

Education and Training Institutions

The School of Natural Resources has expressed interest in cooperating with the project as they see the information base being particularly relevant to their certificate and higher level courses in forestry and physical planning. Given that SNR will continue to be the main institution training field forestry staff in the future, and the FRIS will become the main data filing and checking process for such data, it is important that the SNR be kept fully briefed on the project.

Meteorological Service

The Meteorological Service has computerised records of climate from eight stations and may provide data to FRIS. As users, they have a requirement to plan the installation of automatic weather stations throughout SI and see FRIS as assisting in defining these locations.

Geology

The Geology Division MNR holds data on non wasting hazards and up to four years of data from automatic rainfall and discharge stations throughout SI. As users, they would require FRIS outputs based on their own data bases to assist with any planning they undertake.

2.3 PRIVATE SECTOR USERS

The private and non government sector holds a range of data potentially relevant to forest resource utilisation, they ultimately represent the main users of the forest resource. The logging industry through its in field operations and negotiations with customary land owners has a wealth of information on forest yields, location of tambu sites and "no go" areas etc. Much of this information is anecdotal and significant amounts are not available in English. For example, pre investment inventory data from Korean firms is in Korean. The non government agencies operating at the community level also have a wealth of information through their involvement with "mobile sawmills", "sustained use" extension programs and environmental awareness education activities.

The difficulty in accessing these data sets is because it is private data, sometimes regarded as commercially confidential, and not held by the public agencies. Furthermore the standard of the data, particularly the anecdotal information, is difficult to verify. In addition, these data sets are site specific in most cases.

Both sectors will have a legitimate requirement to access the forest or agricultural planning data that results from the establishment of FRIS. It is important to note that private sector access to industry and environment plans is the key requirement. FRIS will not compile these plans: the governmental users discussed above will be responsible for compiling the plans using FRIS as a tool.

CHAPTER 3

STRUCTURE OF THE FOREST RESOURCES INFORMATION SYSTEM

This chapter covers the conceptual structure and design of FRIS. It is based on the review of available data (Chapter 4), the assessment of user needs (Chapter 2) and the definition of the data which will be generated by the project's FSS, API, Environmental and Sociological components.

3.1 APPLICATION OF INFORMATION SYSTEM TECHNOLOGY

Resource information systems generally fall into two broad groups - those that are not computer-based and those involving some degree of computerisation. The Land Systems work in SI, PNG, Australia and derivatives used in Africa are examples of hard copy resource information systems. Because of the sheer bulk of accumulated resource information, classifications that summarised the resource attributes were necessary. With the advent of computers, it became possible to hold large amounts of site specific data on vegetation, soils, landform, land use and land capability summarised into these classifications.

Suitable computing facilities were not available in the time of Hansell and Wall, so there is no published or computerised data base containing all of their many thousands of site descriptions of land, soils and vegetation. Similarly, computerised systems were not available at the time that land systems were mapped in PNG and a very large amount of forest inventory field work (equivalent to the FFS component of this project) was completed.

Computerisation of resource data became possible by the late 1970's when the first large scale resource assessment surveys in Australia were done using main frame computers to process the site data (for example the Western Arid WALRUS series of land resource surveys covering all of Western Queensland).

An innovative approach was used in the late 1970's and early part of the 1980's in PNG to effectively computerise the old hard copy land systems data, this ultimately resulted in the PNGRIS system. The PNGRIS system effectively overlays maps of land systems, land tenure, climatic regime and census information to produce small areas which are homogeneous for the attribute represented by each of the overlaid maps. Each small area is referred to as a Resource Map Unit (RMU). The variable represented by each of the overlaying maps creates a field (column) in the attribute database and the database contains one record (line) for each RMU. The RMU drawn on the map and its attributes in the database are identified by a unique number or identifier. The spatial information was not computerised, that is, the maps of the RMU were hand drawn. Forestry inventory data were not integrated into the system.

A major development in the mid 1980's was the availability of micro computer driven software that could "read" the computerised attribute data base and hold the spatial information for display. These programs, called Geographic Information Systems (GIS) allowed the user to interrogate the map and attribute data base together as one data set.

PC ARC/INFO was used for these purposes to develop small area resource information systems. An example of such an inventory involving forestry is the system developed for the World Heritage Area in North Queensland. This relied on both field data and resource attribute mapping using remote sensing techniques. The same software is now used for land resource surveys in Queensland. Although micro computer driven, PC ARC/INFO is not "user friendly", is relatively expensive and the operator requires advanced computing skills to operate it successfully. The GIS software available today effectively overcomes the limitations for resource planners posed by the technology used in PNGRIS and the complexities of PC ARC/INFO.

3.2 THE RMU CONCEPT

The central concept behind the information systems either in place in PNG or being developed in Vanuatu is the Resource Map Unit (RMU). This is based on the definition of a geographical area with an implied unique set of attributes. In Vanuatu, the attributes used are (Working Paper 1 VNFRS, March 1990):

Natural Vegetation Type
Land Use Intensity Class
Landform/Relief Type
Rock Type
Slope Class
Altitude Class
Rainfall Regime

These criteria were chosen because they are relatively "time constant". In effect, the RMU is a spatial area to which is tagged a series of natural resource attributes. These core attributes define the boundary of the RMU. Unfortunately, in areas with an active logging or subsistence farming sectors or with vegetation forms prone to cyclonic disturbance (as in Solomon Islands) the RMU, cannot constant with time in its spatial dimension.

3.3 FRU FORMATION

FRIS utilises the RMU concept to a limited extent. The Forest Resource Unit (FRU) is defined in a manner similar to that of the RMU but with fewer attributes. The attributes which define the boundaries of the FRU are land cover, slope (broad classes only) and in some cases (discussed later) Hansell and Wall's Land Systems. FRUs will also be restricted by the boundaries of Sub Regional Units. Of these attributes, only land cover is variable with time.

Figure 3.1 shows how the FRU can be formed from slope and land cover data. In practice the land cover boundaries (derived from API), the slope boundaries (derived manually from 1:50,000 topographic maps) and the 400 metre contour are drawn on the same map, the intersections then define the FRU boundaries. The FRUs are digitised (electronically traced) into the FRIS using a digitising table.

After inspection of the resulting FRU map the RIC may decide to further subdivide some FRUs using Hansell and Wall's Land System (LS) Boundaries. FRUs are only subdivided by LS boundaries where the resulting FRUs are of significant size and the LSs on either side of the boundary have significantly different characteristics. It is anticipated that only a small proportion of FRUs will be subdivided in this manner, and that this will usually occur in Priority 3 (upland) areas.

The FRUs derived in this manner are simple (ie they have relatively few attributes) and therefore easy to update and maintain.

3.4 SPATIAL UNITS USED IN FRIS

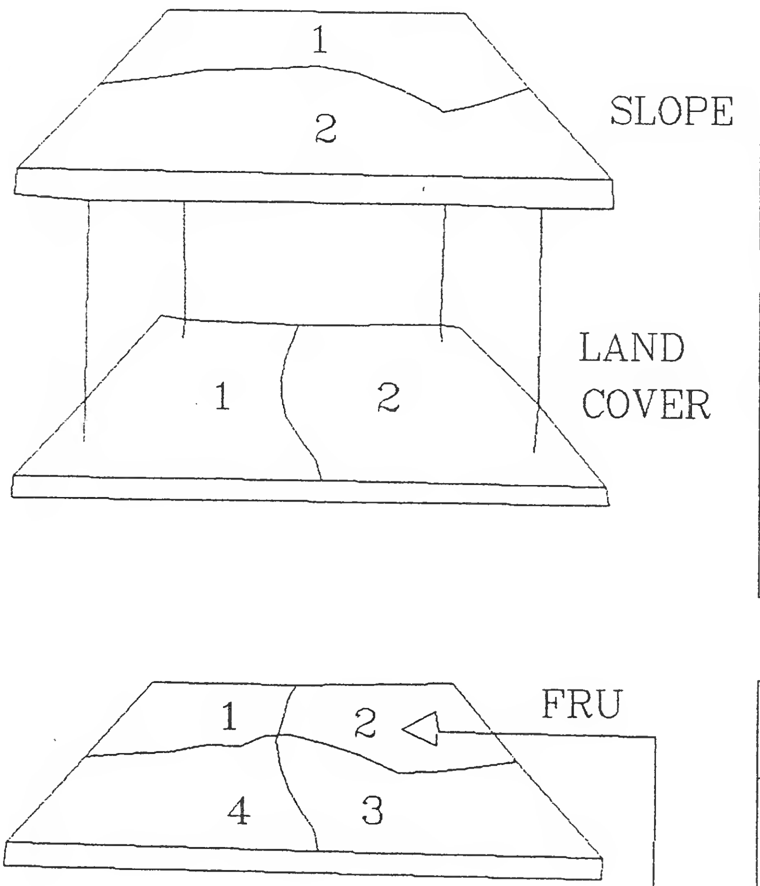
As discussed above, the FRU is the 'building block' of the FRIS. Once defined, the FRU is not subdividable, that is, all calculations performed by FRIS are based on whole FRUs. The following spatial units of the FRIS are therefore aggregations of FRUs (see figure 3.2) .

* Sub Regional Unit (SRU)
  SRUs are areas with defined (usually) natural boundaries and are used to define the FFS sample areas. SRU boundaries will coincide with watershed boundaries, rivers, coastline, defined ridges, elevated country, roads or agricultural and urban development.

* Regional Unit (RU)
  RUs are made up of islands or island groups and are formed by aggregations of SRUs. There are approximately eight RUs covering SI.

Figure 3.1

FRU Formation



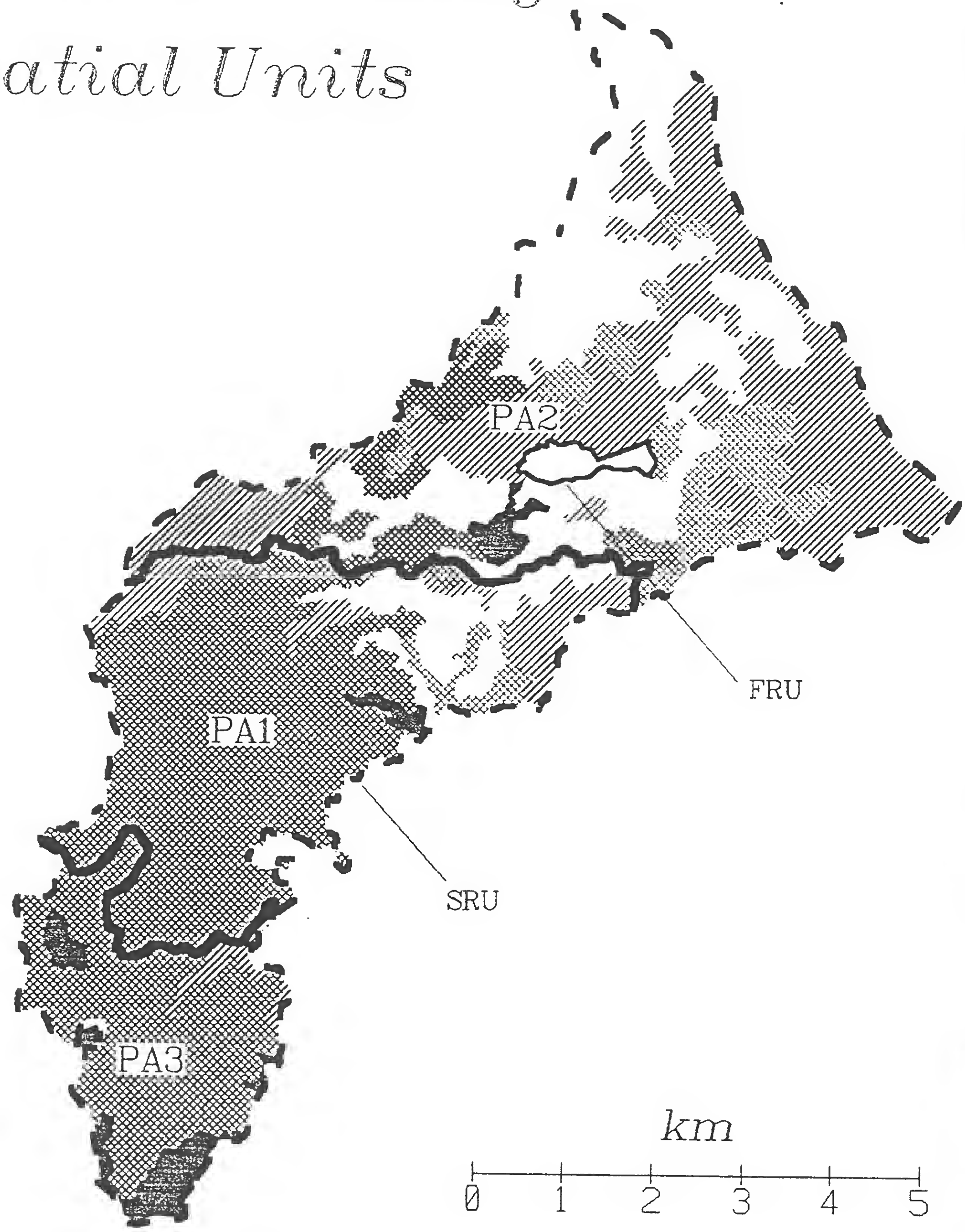
	SLOPE
1	>30
2	15–30

	LAND COV
1	FPM2
2	FHM3

	SLOPE	LAND_COV
1	>30	FPM2
2	>30	FHM3
3	15–30	FHM3
4	15–30	FPM2

Figure 3.2

Pilot Area Showing Spatial Units



Solomon Islands Forest
Resources Information System

* Priority Area (PA)
  Each SRU will be divided into three priority areas based on the viability of the forest for logging. The PAs are defined as follows (see working paper 9 for a fuller discussion).

  Priority Area 1 (PA1) is the area of SI below the 400m contour and approximately 15 degrees of slope, have a canopy height of 20m and contain 20 cu m per hectare or more of timber that is judged merchantable.

  Priority Area 2 (PA2) is the remaining land below the 400m contour where the forest is depleted.

  Priority Area 3 (PA3) is the remaining land above 400m or above the limit of accessibility (about 15 degrees).

3.5 DATA STORED BY FRIS

Table 3.1 shows the data stored by FRIS for the pilot project. The data can be separated into two categories; that which is directly related to the FRUs, and that which comes from third party sources and is used as supporting data for the primary data.

Primary data is created by the FFS or API or is derived from the supporting data. The only graphical information in the primary data are the FRU boundaries and the positions of FFS plots.

The interaction between the primary and supporting data can be seen in table 3.1, for example, note that each FRU has a dominant Land System attribute - this is primary data, whereas the Land System boundaries themselves are supporting data. MAPINFO is used to 'pass' the dominant Land System (the one covering the largest area of the FRU) through from the LS boundaries to the FRU database. If the land cover of the FRU changes due to cyclonic action or the activities of man it is then a relatively simple matter to update the dominant LS attribute of the new FRU.

FFS data is related to the FRU by identifying the sample plot positions using API techniques and plotting them onto a map. These points are then digitised into the FRIS and MAPINFO functions are used to update the plot database with the identifier of the FRU in which they reside. FRIS is then able to use the plots and sampled trees in conjunction with the attributes of the FRU for checking of the field and API data, and for analytical purposes.

Item	PRIMARY DATA Description	Type	Source
DATA STORED EXPLICITLY FOR EACH FRU			
FRU	Unique FRU identifier incorporating Regional unit, Sub regional unit and sequential FRU number.	TG	FRIS
LAND COVER	Land cover code	T	API
AREA	Area in Hectares	T	FRIS
PROVINCE	Province Name	T	FRIS
ISLAND	Island name	T	FRIS
LAND SYSTEM	Dominant Land System	T	H and W
AOA	Dominant Agricultural Opportunity Area	T	FRIS
WATERSHED	Watershed name	T	FRIS
SLOPE	Dominant Slope Category	T	FRIS
PARCEL	Dominant Alienated parcel (if any)	T	FRIS
DATA ACCESSIBLE THROUGH EACH FRU			
LAND COVER			
DESCRIPTION	Forest/Logged/Urban etc.	T	API
TYPE	Swamp, Lowland Rain Forest	T	API
CANOPY	Canopy Density	T	API
SPECIES	Dominant species for this forest type	T	FD
MERCH	Generally Merchantable True or False.	T	FD
LAND SYSTEM			
MATRIX A	LS Characteristics Matrix including crop suitability	T	H and W
WATERSHED			
CLASS	Watershed Classification refer Annex 6	T	FRIS(1)
DESCRIPTION	Classification Description	T	FRIS(1)
FIELD DATA RELATED TO EACH FRU			
SAMPLE PLOTS			
PLOT	Unique identifier for each plot - consists of Regional unit, Sub RU and plot Id	TG	FFS
TYPE	Circular, strip etc	T	FFS
DATE	Date of survey	T	FFS
PARTY	Collection Party	T	FFS
LAND COVER	Observed Land Cover	T	FFS
CYCLONE	Rating of Cyclone damage	T	FFS
SLOPE	Observed Slope	T	FFS
SPECIES	Species of recorded trees	T	FFS
MERCH	Merchantable of species	T	FD
FORM	Average Form factor of spec	T	FD
CUSTOM	Customary Uses	T	FD
USES	Uses of Timber	T	FD
FORM	Form factor of this tree	T	FFS
DIAMETER	Diameter of Tree	T	FFS
LENGTH	Millable Log Length	T	FFS

Table 3.1 (a) Structure and Content of FRIS

Item	SUPPORTING DATA Description	Type	Source
CLIMATE			
RAIN	Annual rainfall isolines	G	Met Service
SEASON	Seasonality	T	Met Service
CYCLONE	Cyclone Incidence	T	Met Service
ADMINISTRATION			
WARD	Ward Boundaries	G	DSL
VILLAGE	Village Name and Location	TG	GSO
CENSUS			
ENUMERATION	Enumeration areas and statistics	TG	GSO
VILLAGE	Village Statistics	T	GSO
LOGGING LICENCES			
NAME	Name of concession	T	FD
CONCESSION	Boundary of concession	G	FD
STATUS	Active / Inactive	T	FD
QUANTITY	Quantity Approved	T	FD
LOGGED OVER AREAS			
BOUNDARY	Boundary of logged area	G	FD
DATE	Date Logged	T	FD
PROVINCES	Province boundaries	G	DSL
ISLANDS	Island boundaries	G	DSL
LAND SYSTEMS	Land System boundaries	G	H and W
AOA	Agricultural Opportunity Area boundaries	G	H and W
WATERSHED	Watershed Boundaries	G	DSL
SLOPE	Slope class polygons derived manually from 1 : 50000 topographic maps	G	DSL
CADASTRE	Alienated land boundaries	G	DSL
COAST	Detailed Coastline from 1 : 50000 mapping	G	DSL
RIVERS	Detailed rivers 1 : 50000	G	DSL
FFS PLOTS	Positions of FFS sample plots	G	API/FFS
AIR PHOTO KEY		G	API

Table 3.1 (b) Structure and Content of FRIS

Notes Relating to Table 3.1 (a) and (b)

1. Code in TYPE column indicates whether the data is Graphical (G) or Textual (T)
2. FRIS in SOURCE column means the data is captured by FRIS or internally generated.
3. FRIS(1) in SOURCE column means the data is derived from auxiliary analysis outside of FRIS, the results of which are imported into FRIS.
4. H and W refers to data captured from work performed by, or following from, Hansell and Wall.
5. This table is not definitive: data may be added to the tertiary group as appropriate.

Supporting data is not created by the FRIS, but may be used for map production and analysis. As outlined above, the supporting data will often be used to 'fill in' an attribute of the Primary data. The list of supporting data is by no means exhaustive, it is expected that more data will become available as the project progresses.

The user will be able to interrogate the supporting data whilst viewing the FRUs, for example, the rainfall regime for the area being viewed will be available. It is often not appropriate for graphical data to be visible at small scales due to the uncertainty in the actual position of the boundaries. In the rainfall example above, the user should not be able to see the rainfall isolines except at a national or island level because of the 'fuzziness' of the lines. FRIS will prevent the visibility of 'fuzzy' data at small scales.

CHAPTER 4

REVIEW OF DATA SOURCES

4.1 FOREST RESOURCES

National Level forest inventory data is not available for the Solomon Islands. The only national coverage is that of Hansell and Wall which maps forest types or classes, but does not contain quantitative information of direct importance to forest utilisation - be that commercial utilisation or customary uses. The forest classes are however useful for planning the field work and API program. In addition there are several FD forest type and traverse surveys (some with volume tables) available which date back to the 1950's for small areas of the Solomon Islands. Logging companies hold their own records from pre-investment studies - often in foreign languages. The commercial company data has not been collated but the other data has been collated and reviewed (covered in more detail in WP 4).

A comprehensive list of forest species has also been compiled by Hancock and Henderson (1988). This inventory is notable for its inclusion of common names as well as a classification which places particular emphasis on the traditional uses. The listing contains some 3500 separate entries (i.e. species). Its major deficiency is that there is no map of the distribution of the species nor any ecological association which would allow extrapolation from other resource information such as land systems. This data base is held in computerised form by the Herbarium in DBASE format.

A summary listing of the tree species, with uses, is given in Annex 4 along with those species presently forming the tree species identification list used in the pilot area FFS. The two lists show the overlap of usage between the traditional and commercial sector, and the extent to which the FFS will (by default) collect data on traditional as well as commercial species.

Whilst the Henderson and Hancock work has no geographical data, the Herbarium has a listing in DBASE of all accessions to the herbarium in recent years with longitude and latitude of the collection point, and a similar but less extensive DBASE list exists for fauna. This is supplemented by a DBASE file for scientific and common names in four major language groups of the Solomon Islands covering approximately 500 species.

RECOMMENDATIONS

1. That the Forest Classes of Hansell and Wall not be digitised. As the field inventory program comes to areas which have previously been typed by the FD, the existing traverse and map data be reviewed in detail by the FIS and API specialist and a decision made at that time as to whether the historical data should be entered into the information system. If so, the data should be held as supporting data. Similarly the existing inventory data from the plantation sector should be reviewed and if justified included as supporting data.

2. A prototype tick sheet (presence or absence of a species) should be developed for use in the field survey to record the occurrence of species of customary importance. These data sets should be held as supporting data of the FRIS as an attribute point file. The Environmentalist (ENV) should review the data on an island by island or province by province basis, and determine any environmental relationships which will allow extrapolation to other FRUs of the same forest type. The value of the data for identifying areas containing rare and endangered species and their associated forest type habitats should then be assessed.

3. The DBASE listing of Hancock and Henderson's work be obtained and incorporated into the FRIS to act as a reference for the conversion of scientific names to common names. In addition the Database Specialist and the FIS should assess whether data from the Herbarium on scientific and common names should be included to allow field teams to verify scientific names versus common and dialect names before data is entered to FRIS. This should be done in close collaboration with the Herbarium staff to ensure that misapplication of common names does not occur.

4.2 FOREST UTILISATION

Commercial logging licence data is available from the FD. The current active and approved licences (i.e. 1990) have been extracted from the files. Extraction of the old licences which will give an indication of logged over areas is important, however, this will take some time. The difficulty with this data is that licences apply to ward areas, but not all of the nominated ward may have been logged. However, the data is still regarded as an important aid to the API for assessment of logged over areas and thus to any assessment of the rates of recovery from logging. It will also highlight any areas where logging operations have "creamed" (removed the high value species component) the commercial forest resource. The data will also be important to the Timber Control Unit.

RECOMMENDATIONS

4. Logging license areas be digitised and also entered as an attribute file of licensee, date of approval, current status and, if available, estimated volume of harvest. During the remainder of this current phase and in the March - June period FD staff should progressively extract the historical data from FD records. In the Implementation Phase this data should be held as supporting data.

5. Where the current logging licenses extend above the 400m contour line, these areas should be incorporated into the Project Area.

4.3 LAND RESOURCES AND LAND USE

4.3.1 Land Systems and Agricultural Suitability.

Hansell and Wall (op. cit.) made an assessment for agricultural development which is based on the land system (LS) concept. This concept and the technical relevance to forest resources, environmental and watershed resource issues is discussed in Annex 3. The level of detail varies with some land systems having up to six land facets (LF) and some having only one or two LFs.

The uses to which the LS can be put depends on the level at which it is integrated into the data base and the extent to which the FFS teams wish to use LS when planning their field work. However, LS cannot provide sufficient detail on vegetation or terrain to allow forest planning at a scale of 1:50,000.

The report of Hansell and Wall is an information system in its own right and has been widely used in the Solomon Islands. It contains the following data sets of possible use to this project:

* Geological/geomorphological information - at the LS level;
* generalised slope and elevation information at either the LS or Land Facet (LF) level;
* generalised soils information at both the LS and LF level;
* vegetation types at the LF levels, this is duplicated at the LS level by their forest type map (refer above), and will be replaced by the API activities in this project;

* generalised terrain shape classification (termed Plan Profile);
* Indicative Land Use (This can be regarded as dated data and of limited value to FRIS except as a historical record of the extent of agricultural areas).

Land systems will therefore be digitised and entered into the FRIS as supporting data. This will be one of the larger data capture tasks for FRIS due to the large number of boundaries. Since each boundary must be closed off prior to commencing the next boundary, each line will be digitised twice. Software is available which has been developed to enable MAPINFO (the Geographic Information System on which FRIS is based) to automatically close the boundaries and reduce the digitising time by at least half. This software should be purchased.

Two other data sets created by Hansell and Wall are also available, namely Agricultural Opportunity Areas and a Crop Suitability Classification.

The Agricultural Opportunity Areas (AOA) are defined as areas of terrain and soils generally suited to agricultural development which were not used extensively for agriculture at the time of the survey. They explicitly did not include a land capability classification in their assessments - but rather, defined AOA·s from a general assessment of where large-scale agricultural development would be possible from a resource point of view.

Significantly, many of these AOA s are within the 0 to 400m altitude zone, however a few are in the "lower and upper montane" zones which are mainly tableland land forms. The AOA s remain the main priority areas for large scale commercial agriculture (including smallholder development) in the Solomon Islands.

A Crop Suitability Classification was prepared by L.D.C. Chase in 1981 to augment the AOA s as an important research and extension source document particularly for the traditional agriculture and smallholder sectors. Unfortunately the classification is not map based, however, it is compiled as an island by island crop suitability reference for the LS and LF. This allows a rating for various cash tree crops and food garden based farming systems to be applied to the Land Systems Map.

The AOA and crop suitability data are significant because they provide a non-forest alternative for post logging land use. They also provide a basis for better integration of the two potentially competitive land uses. The structure of the crop suitability report is such that if the LS and island names are held in FRIS then crop suitability assessments can be derived. If Chase's report was "computerised" the assessments for agricultural potential would be automatic. The tabular format of Chase's report makes this straight-forward via the development of a library file of land systems in the FRIS database. The Hansell and Wall report will have to be converted into a tabular format initially and then entered to the "look up" file.

In addition, the LS data provides a basis for the initial ranking of areas of potential ecological and environmental significance. Land Systems are described in terms of their morphogenetic significance, for example, land systems such as Lungga are described as braided stream channels carrying very coarse bedload materials. These dynamic land systems are important in the context of watershed stability and flooding effects from catchment disturbance. Similarly other Land Systems are described as being indicative of relatively unique geomorphological properties (drowned river valleys or lacustrine plains of restricted distribution at middle altitude areas in West Guadalcanal) or important ecological systems (mangrove estuarine areas in sheltered non "weather coast" environments of the Floridas and Guadalcanal).

A provisional ranking for key criteria that reflect these assessments is given for the land systems of the pilot area and selected Guadalcanal examples in Annex 3.

RECOMMENDATIONS

6. The definition of the project area be extended to cover those AOA s which are above the 400m contour line as logging would logically precede any future agricultural development.

7. The work of Chase be compiled into a look up file attached to the primary data layer of the FRIS. This structure should be modified to allow the geology, plan profiles and facet descriptions from Hansell and Wall report to be added. (NB: Chase's system already contains the Hansell and Wall soils information.) This work should be carried out under the supervision of the RIC.

8. The digitising of the AOA and LS boundaries be completed in the March to June period as single lines, and that the software for closing the boundaries in MAPINFO be purchased.

9. The look up file for crop suitability and land systems should be developed when the forest inventory for the first island is completed, as the existing data set is organised into island by island blocks.

10. The look up file should also contain the provisional environmental sensitivity matrix assessment on an island by island basis.

11. The dominant LS should form one of the attributes of the FRU. This will allow users to access both the forest and agricultural assessments at a common level.

4.3.2 Terrain

Terrain data are important components of forest utilisation planning. Commercial logging is restricted to areas below the 400m contour and slopes of less than about 15 degrees. In practice the shape of incised stream beds determines the accessibility of the forest resource under the 400m contour.

Terrain data in SI is available in two forms. Hansell and Wall (op. cit.) have described broad terrain features as part of the land systems descriptions. The most useful of their descriptive terminology is that of plan profile which summarises the shape of the terrain. Section 4.3.1 recommends that this data be included in FRIS.

The other source of terrain data is the 1:50,000 topographic map series and its associated 40 meter contours.

Because SI is characterised by rugged and broken relief, terrain data is extremely important to FRIS users in the determination of:

- commercial forestry constraints;
- land cover typing;
- environmental/ecological assessment and constraints;
- plantation suitability;
- agricultural suitability.

Hansell and Wall's (op. cit.) data are invaluable as a reference in describing the micro-relief within a land system, but because the facets have not been mapped, it is impossible to assign specific terrain characteristics to a particular site. Map contours on the other hand are usually interpreted subjectively to gain broad non-quantified information for resource assessment.

The terrain characteristics most required by FRIS developers and users are slope and elevation. To gain maximum use of terrain data within FRIS, ready access to computerised slope and elevation (particularly the 400m contour) data is essential.

A brief clarification of terms to avoid any confusion in the terminology follows:

(i) **Spot height digitising** consists of capturing height values along key ridges, gullies and water courses such that a representative skeleton of the terrain is available for subsequent processing. Spot heights can be processed directly into slope and aspect boundaries and the spot heights themselves are already useful data.

(ii) Scanning is the semi-automatic process of converting lines on paper or film into digital lines. The main point to note is that scanning is not a totally automated process. Scanning also only produces digital contours, which in turn must be converted to a grid of spot heights for subsequent processing into slope and aspect boundaries.

Three alternative approaches for capturing the digital terrain data were considered. The following section describes these options and presents their relative advantages and disadvantages.

i) Manual creation of broad slope regions by interpretation of the contour maps and subsequent digitising into the GIS.

This method is relatively fast, low cost, can be performed entirely in SI and is not a major drain on SIG resources. It does, however necessitate digitising the resultant paper based data into the FRIS and it produces virtually no quantifiable aspect and elevation information.

ii) Digitise spot heights in country and process into slope and aspect boundaries in Australia.

This method would allow the flexibility of capturing the data at a resolution consistent with the priority of a particular area. For instance one could capture a detailed spot height network in the foothills under the 400 metre line, and a more sparse network in the rugged interior.

It was found that the capture of the spot heights is not as fast as might be expected because it is difficult to find the elevation of the contours at the point where each spot is digitised. This often involves tracing along a long section of contour to find the place where the height was written.

Australian processing would require approximately four weeks of data processing and quality control work to cover the whole country.

This method has the capability to produce high quality slope, aspect and elevation data provided that the network of collected points is sufficiently dense.

iii) Scanning and subsequent processing in Australia.

There is a possibility that the Australian Defense Cooperation Programme may co-fund the capture of the terrain data. The army has significant scanning resources and could carry out the work as part of its routine activities. However the work may not be considered a priority and time lags may occur.

Technology transfer would be minimal because data capture would be completely out of country. The compilation sheets would also need to be taken out of SI to Australia which may be unacceptable to SIG.

RECOMMENDATION

12. That the manual method of deriving slope regions from the 1:50,000 contours be used to provide slope information and that this task proceeds prior to the Implementation Phase.

4.3.3 Agricultural Land Use

Agricultural land use has been mapped at a national level by Hansell and Wall (op. cit.). However, this work is now outdated and can only be used as a general guide to agricultural demands on the forest resource.

More recently various studies by the Agricultural Economics Section of MAL have investigated the smallholder agricultural sector through the coconut and small holder farming systems surveys. Sample populations from each of the main islands were included. The lack of nation wide coverage makes the incorporation of this data into FRIS of little value.

FRIS will indirectly map agricultural land use via its capture of land cover data, this will effectively create an updated map of agricultural land use for all areas studied.

The MAL farming systems surveys referred to above can then be used to assess the future demands on the primary forest resource when combined with the land use information derived from FRIS. Identification of present and future land use conflicts between agricultural and forestry uses will then be possible.

RECOMMENDATIONS

13. The Hansell and Wall agricultural land use data will not be incorporated into the information system. Data obtained from the API and RS component of this study should be included instead.

14. That the locations of the various industry and village survey data be held as digitised data in the FRIS as supporting data in order that users of the system can be directed to the appropriate publication.

15. The socio-economic data be reviewed on an island by island basis. Emphasis should be placed on assessing whether it will be possible to extrapolate the results of the surveys to the whole or parts of islands using the resource and population distribution data in the FRIS. Emphasis should be placed on assessing the longer term demands on the primary forest resource from shifting agriculture and on identifying those areas which are not sufficiently covered by the existing surveys thus requiring further study as the FFS enters the identified areas.

4.3.4 Climate

Climatic data are available from the Meteorological Service (MS). The most reliable data is that derived from the few meteorological stations maintained by the service. Data from stations maintained by other groups is also generally available from the MS, however the reliability and extent of these records is variable. All data held by the MS is computerised.

Climatic classifications range from that of Hansell and Wall to a more recent and comprehensive scheme devised by the MS. This is available in map form and is based on annual rainfall regimes and seasonality criteria. Because of the limited number of stations, the boundaries between various classifications have been inferred from the topography and other criteria and are very course.

The classification is seen as important supporting data to be included in the FRIS. In Vanuatu, climate is used to determine RMU boundaries. However, because of the coarse nature of the classification in the Solomons, this is not appropriate for this project.

The other climatic information of importance is cyclone incidence data. The MS has divided SI into two regions on the basis of the likely incidence of cyclones in a given year. This is available in map form. In addition the paths of cyclones from the 1960s onwards is available in map form. The pilot study indicated that cyclonic damage, mainly as a result of very heavy rain causing floods and land slips and also wind damage is an important factor. This data should be incorporated into the FRIS.

The MS recognises the lack of adequate coverage of stations and intends to install a network of automatic solar powered stations, starting 1991.

RECOMMENDATIONS

16. The climate classification system and cyclone incidence classification system of MS be incorporated into the FRIS as supporting data.

17. That the cyclonic track data provided by MS be incorporated into the FRIS as supporting data.

18. The climatic data on disk from the MS be obtained and held as supporting data in the FRIS.

19. The project discuss with the MS the possibility of FRIS output being used to assist with placement of the new automatic stations. FRIS could be used to identify areas of forestry, environmental and agricultural potential not adequately covered by the existing station network.

4.3.5 Watershed Classification

Watersheds are significant in defining the main field planning unit (the SRU). The API specialist and FIS will therefore need to delineate the watersheds on airphotos/topographic maps prior to the field work program. The watershed name coding system developed and mapped by Hansell and Wall is not regarded as suitable for the field inventory program, as it is intended to group watersheds on the basis of similar vegetation for the purposes of planning the field inventory.

Watersheds are also useful planning tools because they can be categorised in terms of their sensitivity to degradation and their importance to coastal ecosystems. As each watershed will contain a number of FRUs, a watershed classification based on quantitative parameters would require a complex pattern analysis approach. Alternatively a descriptive classification could be used. An outline of such an system is proposed in Annex 6.

When the inventory is completed for a given regional unit (RU), watershed classifications will be determined. The Geology Division (GD) of the Ministry of Natural Resources has four years of continuous daily discharge and rainfall data from 24 gauging stations located throughout SI. Combined with a mass wasting hazards assessment carried out by the division, this will be of value in watershed assessment.

RECOMMENDATIONS

20. That watersheds be identified as aggregations of Hansell and Wall watersheds as a pre FFS activity.

21. That watershed boundaries be digitised and held as supporting data in FRIS.

22. That the watershed code and name be attached to each FRU attribute record in FRIS.

23. That on completion of the first RU, a watershed suitability classification be developed for ranking watersheds on their broad environmental importance and sensitivity - such an assessment should include the detailed review of data held by GD. This could be done by the Environmentalist together with the RIC and FIS.

4.4 CENSUS AND ADMINISTRATIVE INFORMATION

The 1986 Census population data are available from the Government Statisticians Office (GSO). The data are held at village, Enumeration Area (EA) and Ward levels, and are stored in LOTUS 123 spreadsheet files. The GSO has shown keen interest in SOLFRIP and has provided a copy of the Census for project use. The corresponding map information which indicates the accurate location of the above villages and census boundaries are kept by SCD.

The paper based results of nationwide Village Resource Survey were also located. These data give detailed information on over 4000 villages. The data were collected over the period 1984 to 1985, as such it predates cyclone Namu which could influence its integrity in some places.

FRIS will allow the village data to be totalled within any chosen boundary. For instance the total population of the Pilot Area was determined using this method. The village location and census data may also form the basis of generalised extrapolation of the results of the Sociological Survey. EAs are of limited usefulness, but Ward boundaries on the other hand have legal, administrative and political significance.

The ward boundary is the basic unit of political and administrative aggregation: national, provincial and Local Area Council (LAC) boundaries are all based on aggregations of wards. The LAC boundaries have particular significance as the process of allocating logging licences involves close negotiation with the LAC, as it is the closest link to the customary land owner. It should be noted, however, that ward boundaries do not represent customary boundaries and that they should only be adopted as administrative approximations of clan groupings.

With a few rare exceptions there are two categories of land ownership in SI: alienated land and customary land. Customary land is that land owned by the traditional clans. Alienated land is that land which has been alienated from the customary owners and is registered under the Land and Titles Act.

Unlike other Pacific nations, no system of customary land registration exists in SI. A major reason for lack of investment in the rural lands in SI is the low security of tenure afforded by the system of customary land ownership. This is of critical importance in the development of ventures such as afforestation where long term security of tenure is a necessity. Customary ownership legislation is presently being considered by the National Assembly, but this is unlikely to be passed into law in the near future.

Alienated lands can be held under a number of estates including leasehold, fixed term or perpetual. They are controlled by a well administered legal and land survey system. Although the internal boundaries are changing constantly, it is government policy to minimise the expansion of alienated land and as a result the external boundaries are virtually static. Alienated land boundaries are available for most of SI as paper based lists of coordinates. These are suitable for entry into the FRIS using the input and translation programs already produced by the DS.

RECOMMENDATIONS

24. That the village level census data of 1986, which includes number of households, gender and age groups be converted from spreadsheet format to DBASE format and entered into FRIS, and that the associated village locations and ward boundaries be digitised into the system and held as supporting data.

25. That the coordinates defining the boundaries of the alienated land be entered into the FRIS by a SCD operator during March to June, 1991 using the programs already provided. The data should then be imported into the FRIS as supporting data.

4.5 BASE MAPPING

Spatial analysis of the FRIS data would be meaningless if the various map layers in the system could not be overlaid with a high degree of confidence. For instance, environmental and ecological limitations must be correctly displayed relative to the areas considered to have high commercial timber values, if meaningful inferences are to be made from the data. The following section describes the procedures that will be used to ensure that highly accurate maps are captured. The methodology was thoroughly tested during the Inception Phase.

The concept of an accurate, nationwide "base map" will be adopted and all subsequent digitising work will be based on this layer.

Fortunately SIG has the original film compilation sheets of the 1:50,000 topographic series available as a readily accessible data source. The film is of high quality, dimensionally stable and will therefore form an excellent base. A common linkage between all mapping in the project, is the coastline and drainage system. It is particularly relevant in SI because of the relatively small size of the islands and the large number of rivers and creeks (in fact, all of the 1:50,000 sheets contain some coastline). The coast and drainage layers of the 1:50,000 topographic series will be adopted as the base map.

The compilation films will be digitised one at a time. The sheets fit within the active area of the A1 digitising table minimising the necessity of joins within sheets. A simple, yet rigourous, checking routine has been developed involving an accuracy check each time a map placed on the digitising table. If inaccuracies fall outside a set limit, the map is re-registered. This process has already been accepted as a routine part of digitising. Each map will be checked manually to ensure that it fits accurately with the adjoining sheet.

Other graphical layers of the FRIS will be referenced to the base layer. Two points will be chosen from the data being digitised which can readily be identified on the base map, the points are then matched to provide the coordinates for the new data. In the event that the new data is slightly distorted due to creases in the paper or the quality of the mapping, it will be adjusted by the digitiser to fit the base map.

A major feature of the FRIS is that it will allow the user to examine the country at a national level and then to "zoom in" on areas of interest and examine them in more detail. This approach would be impossible if the FRIS data were stored on cartesian UTM grid because of limitations imposed by the six degree zone boundaries. The system will therefore be digitised in latitude and longitude co-ordinates. It should be noted that distances and areas will be provided in metric units appropriate to the scale at which the user is working.

The SI personnel designated to digitise the base maps have been chosen from the photogrammetric section of MAL and are very familiar with the concepts of co-ordinate accuracy. The concept of locally fitting new data relative to the more accurate base layer has been tested and has proved viable.

In summary the procedure will achieve the following:

* accurate control for all spatial data entered into the FRIS;

* total technology transfer, in that the procedure does not depend on external inputs;

* a truly national system that will allow analysis at both the macro and micro levels.

RECOMMENDATION

26. That the 1:50,000 topographic film composition sheets be digitised prior to the implementation phase to provide base mapping for FRIS and control for subsequent digitising.

CHAPTER 5

SYSTEM REQUIREMENTS

5.1 INTRODUCTION

This chapter provides a conceptual introduction to the features and facilities to be provided by the FRIS, including data entry and maintenance, processing, security, output and analysis. Chapter 6 describes the steps undertaken during the inception phase to create the software to meet some of these requirements.

Broadly speaking, all information systems, whether they are computerised or not, must provide :

* a means of entering information (data entry);
* procedures to maintain the data once it has been entered;
* some form of processing or collation (data processing);
* access to the data for queries and reports (output).

5.2 DATA ENTRY

FRIS stores and manipulates both spatial and attribute data. Spatial data is information which is derived from maps, plans etc. Examples include land cover boundaries, land system boundaries and village locations. Attribute data is the textual or descriptive data which is attached to the spatial data. (Refer to Table 3.1)

A variety of methods will be employed to enter information into FRIS, depending on whether spatial or attribute data is being entered. Spatial data is usually digitised, however when the data is provided as a list of coordinates or in computerised form it may be entered directly. Attribute data is usually provided as textual listings on paper and must be entered through the computer keyboard, however it may be provided in computerised form. Attribute data may also generated by spatial operations within FRIS, for example FRIS will update the ISLAND attribute of an FRU simply by using the geographic location of the FRU to determine which island it is within.

5.2.1 Entry of Spatial Data

The MAPINFO system on which the graphical component of FRIS is based, provides sufficient facilities for map digitising without any modification. MAPINFO's digitising functions have already been used extensively to capture the graphical pilot area data.

The alienated land boundaries will be provided by SCD as paper based lists of coordinates. FRIS should provide facilities for the coordinates to be entered, maintained, and translated into a format suitable for input into MAPINFO.

5.2.2 Entry of Attribute Data

FRIS will contain attribute data from many sources, however FFS and EEFS will generate the greatest volumes and will require the most effort to input.

It is anticipated that the FFS will generate approximately 5000 pages of field book data. This data will be entered into the FRIS via a data entry form designed to resemble the field book layout. The API team will locate each plot on a 1:50,000 base map and this data will be digitised. The computerised field data will then be automatically linked to the digitised map positions. Integrity routines will be incorporated into the system to check for incorrect entries.

FRIS will provide similar facilities for the entry and verification of the data collected by the EEFS.

FRIS data entry screens will check that coded entries have been entered correctly by use of look up tables, for example the land cover codes developed by the API specialist will be stored in a table to enable the system to check codes entered by the data entry operator. The system will provide facilities to enter and maintain these lookup files.

5.2.3 Data Already in Computerised Form

1986 census data was obtained during the Inception Phase. The data is stored on 12 floppy disks in LOTUS 123 format. These files will require rearrangement from their present paged format to a flat file format suitable for FRIS. Certain fields will also need to be manipulated and interpreted. The associated census map information held by SCD will be digitised and the attributes and graphics linked. This process was thoroughly tested during the Inception Phase.

The Herbarium accessions list and the ECD fauna and flora records are already in DBASE format and many records already contain latitude and longitude coordinates. After close examination, those records of sufficient value and integrity will be entered directly into the FRIS.

5.3 DATA PROCESSING

FRIS will provide a wide range of data processing facilities. Some of the facilities are internal to FRIS, that is, they are only used for maintenance of the data integrity within FRIS, and some will perform analytical functions for the user.

The most significant data processing function of FRIS will be the estimation of timber volumes. The application of the necessary mathematics is one of the tasks of the Implementation Phase and will be included as a FRIS function when it is available.

The inclusion of MAPINFO in the FRIS means that the user is able to perform calculations based on spatial operations, such as totalling variables (e.g., population) within regions. As the system is utilised throughout the Implementation Phase, any calculation of this nature that is performed routinely should be automated.

5.4 DATA MAINTENANCE

Data entered into FRIS will not be static: it will often be changed due to errors in the original entry or to physical changes in the real world that it represents. FRIS must allow the user to edit the data using the same validity checks as were used during data entry.

5.5 SECURITY

Computerised systems must provide some level of security to prevent both malicious and accidental damage to the integrity of the data. The system must also keep a history of operations performed on the data, including the identity of the operator. Security is also essential where data is sensitive, to prevent unauthorised interrogation of the system.

FRIS will incorporate a multi-level security system where each operator will be given a user name and password which will only allow them access to appropriate system functions. The system will also record their actions whilst they are 'logged in' to FRIS. This level of system security will prevent most damage to the system, however it should be noted that it is very difficult to make a system such as this totally secure. Establishment of a regular and rigourous backup routine is the only guarantee of data safety.

5.6 OUTPUT

The FRIS will contain a large volume and wide variety of data pertaining to the timber and non-timber values of the forest resource. The FRIS design will allow the user to access the information rapidly , it must present the data in a way that ensures that it is difficult to draw incorrect inferences from that data.

Although most of the statistical data will be stored in the attribute database, the means of accessing that data will often be through the intuitive process of analysing the screen map using a system of relatively simple menus. In effect, the digital maps will become an index to the data and the user will be insulated from the complexities of the attribute database.

Spatial data will be categorised by its reliability at certain scales. Map data will only be available for screen inquiry if it is being accessed at a scale at which it is reliable. For instance, land cover information will be accessible at a scale of 1:50,000. At this scale climate data will be inaccessible except as printed tabular output qualifying the regional nature of the data.

Generally the primary data will be accessible at 1:50,000 with the supporting data at progressively smaller scales, dependant on the source of the data. The system will not allow the user to view or access data at a scale of less than 1:50,000.

Volume estimates will not be given for non sampled areas, except at the regional unit level where such extrapolation becomes meaningful.

FRIS will provide a range of predefined reports and maps which will be developed as the requirements of the various users become clear. Advanced users will also have access to facilities for producing both custom maps and reports. Custom output should only be produced under the supervision of the FRIS manager to ensure that the output is consistent with the accuracy guidelines set out above.

5.7 ANALYSIS BY AUXILIARY SYSTEMS

Most users of FRIS will require output from the system either as printed reports or maps, however some will require data in computer readable form to be used with other software for analytical purposes. It is also possible that, after analysis, the modified data will be suitable to be reimported into the FRIS.

As an example, environmental assessment is intended to identify those areas which are regarded as sensitive on ecological grounds. For details on the proposed environmental sensitivity classification see Working Paper number 3. This analysis will be performed using the E-RMS software package probably on a separate computer.

FRIS should include a menu option which exports data in a format suitable for translation into the formats of other software packages. It will be the responsibility of the managers of the auxiliary systems to develop the routines necessary to convert from the FRIS data format to their own system data format.

If the data created via auxiliary analysis is considered to be of sufficient relevance and integrity then it will be imported into the FRIS for general inquiry by users. The environmental sensitivity classification falls into this category. Independent analysis will be carried out by the environmental group and any relevant map and attribute data created will be added to the FRIS.

CHAPTER 6

FRIS SOFTWARE DESIGN AND DEVELOPMENT

6.1 INTRODUCTION

Software developed during the Implementation Phase of the project was required to both provide a demonstrable system to test and prove the system's viability, and to provide a framework on which to construct the remainder of the Forest Resources Information System. It was decided that all design and software production during this phase should have direct relevance to the Implementation Phase, and not be produced and then discarded. After earlier work by the GISS and RIC had already proven the applicability and acceptability of the database and GIS systems chosen for the pilot study, it remained to design the applications software and to test the feasibility of that design. This chapter covers the design philosophy of the FRIS, the mechanics of producing the software to that design and a summary of work performed on the FRIS to date.

6.2 PRIORITIES

Due to the requirements outlined above, the Database Specialist (DS) developed the following priorities .

* To produce a system design for the primary data group consistent with the requirements and philosophies of the project inventory and environmental specialists (see Annex 7);
* To reformat existing pilot study data into a format to enable testing of the design;
* To design the user interface to be used throughout the system;
* To produce sufficient software based on the design to enable the implementation phase to commence speedily and to allow demonstration of the design concepts, and
* To test elements of the design through data entry by a Solomon Island operator utilising software written to conform to the design.

6.3 INTRODUCTION TO FRIS

FRIS is constructed of two types of data, graphical or mapping data and textual or attribute data. The power of the system is due to its ability to manipulate and display the two discrete data types together. As a typical example, the system is able to display the boundaries of FRUs and to colour them based on ecological, sociological or forestry values in the textual database.

The MAPINFO Geographic Information System is used for graphical display and analysis, and the FOXPRO relational database manager is used for the input, storage and manipulation of the attribute data. FRIS integrates these two packages, effectively isolating the users from the intricacies of the packages, yet providing them with the power and flexibility of both.

6.4 FACILITIES PROVIDED BY FOXPRO

FOXPRO is a DBASE compatible relational database manager produced by FOX software of the United States. It provides an ideal tool for developing the attribute management part of FRIS because it is totally compatible with the DBASE format data files used by MAPINFO. FOXPRO also provides a wide range of presentation facilities such as pull-down menus and windows, a powerful report generator and an extremely diverse programming language. The programmer is able to utilise these facilities to produce the user interface and processing facilities outlined above.

6.5 FACILITIES PROVIDED BY MAPINFO

MAPINFO provides the graphical interface to the FRIS. It not only allows the user to display data pictorially but also has many useful query and analysis functions. MAPINFO works directly on the databases maintained through FOXPRO. MAPINFO also utilises additional data such as coastlines, rivers, and ward boundaries, see Table 3.1.

Using MAPINFO, the user will be able to select regions over which a FOXPRO textual report will be printed, produce thematic (coloured or symbolised) mapping to represent the value of a variable (such as slope), observe spatial trends and relationships (does one forest type consistently occur in a given slope category?) and check data produced through field observation (FFS) against data obtained from API.

MAPINFO'S ability to calculate areas will be used extensively in the inventory calculations.

6.6 DESIGN PHILOSOPHIES

Broadly speaking the design of this system can be divided into two components: the conceptual design or user requirements specification and the detailed system design.

The user requirements specification identifies the data to be stored in the system and the basic functionality of the system. The system design produces a structure for the storage of the data, definitions for the required software and the specifics of the user interface and system operation. The former is adequately covered in earlier chapters. This chapter deals with the detailed system design.

At the outset it was decided to limit detailed design to the primary data during the Inception Phase of the project, with an eye to the integration of the supporting data during the Implementation Phase. Work concentrated on the design of data input and validation routines with little emphasis on analysis and output at this early stage. The Implementation Phase of the project will contain a significant design component to enable the DS to cover these functions.

In contrast to projects with definite objectives and methodologies the FRIS is, to some extent, experimental and the requirements, or perceived requirements, of the system will change with time. It should also be noted that for many of the participants in this project this will be their first encounter with structured design and they will not necessarily be able to accurately predict their requirements. In order that the system successfully fills the users' requirements the system designers must accept that the finer points of any design will have only a very limited life.

Even though the detail of the design is somewhat elastic to allow for redefined requirements, the basic structure of the system should remain constant. Items of the design such as screen layout and user interface functions will remain constant; therefore considerable effort was made to ensure they will not require change.

It is most important to realise that there is nothing experimental about the programming involved in this project, the programming to be performed is relatively routine. The challenge for the designer and programmer is to gain an understanding of the users' requirements and to build a system which adequately meets those needs. Due to the elastic nature of the users' requirements (in this case) the design will not be immensely detailed, but will concentrate on the major structural and operational components of the system.

6.7 USER INTERFACE

The User Interface provides the 'look and feel' of the software to the user. The screen menus, layout, input screens and almost every characteristic of the system as seen by the user is covered by the design of the user interface.

From the users' perspective, particularly where the users are relatively new to computing, good design of the user interface is critical to effective operation of the software in both the long and short terms. It is safe to say that if the software is difficult, slow and/or cumbersome to use, then interest in using the system and hence productivity will be low, or in extreme cases, non existent. To this end, a great deal of effort was put in to the design of a consistent, simple and intuitive interface for the FRIS.

Since FRIS is composed of both the MAPINFO graphical interface and the FOXPRO textual interface, the user interface can never be totally consistent. Fortunately both systems use mouse driven menus (that is point and shoot to select an option) and both support 'hot key' (hit the first letter to select the option) menus, so there is some degree of similarity. In the FRIS both systems display their help messages on the bottom line of the screen and both can be operated with either a mouse or keyboard. Despite some cosmetic differences between the two environments the user should be able to swap from one to another with minimal confusion.

The FRIS database user interface (see Figure 6.1) was designed to incorporate simplicity and clarity with minimal screen clutter. A pull down menu system was incorporated to allow easy mouse or keyboard selection of system functions, including input screens and reports. Colours were used sparingly to allow the system to be used successfully on laptop computers.

A primary goal of the design was to minimise the number of menu choices presented, instead, the system anticipates required actions, making the system more intuitive to use. A typical, and standardised, example within FRIS is that the user never has to check for existence of an item of data before adding - the system will automatically check the identifier for the data and, if it exists, allow the user to edit the existing data. Whilst this is by no means an unusual feature of database systems, it is indicative of the assumptions made for the user throughout.

Lookup tables, range and format checking are used extensively to help prevent entry of erroneous data. Exit keys such as the Escape key have been disabled to prevent half entries, and explicit user verification is required for drastic action such as data deletion. Help messages on the bottom line of the screen prompt the user for the next required input or selection.

The screen shown in Figure 6.1 is used for entry and maintenance of field data from the FFS. Features which are common to all FRIS database screens include :

- A topline menu with the standard edit screen options of EDIT/ADD, DELETE, PACK and QUIT.
- A screen border which surrounds the screen and displays the name of the current operation, in this case "Field Book Data Entry".
- A column of entry fields on the left of the screen for the header information for the data being entered. The first line of entry in this area is always the identifier for the data and is checked on entry to see whether the data already exists, in this case Plot and Type fields jointly identify the sample plot.

- Status messages next to entries where lookup tables have been used to verify the data (next to Plot Type and Land Cover).

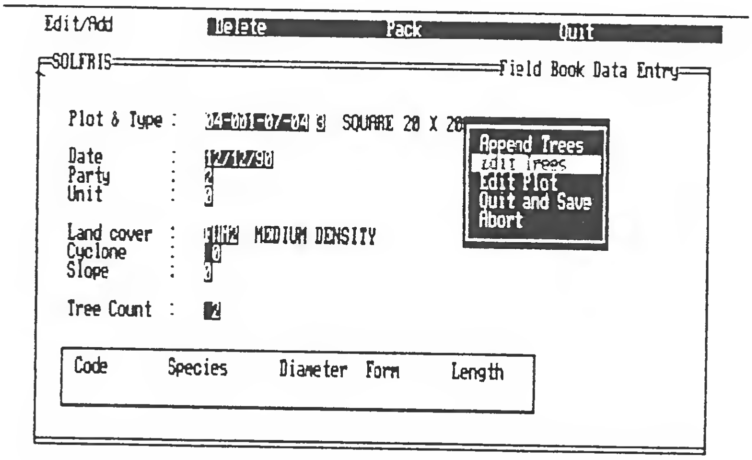


FIGURE 6.1 - A Typical Data Entry Screen

- A box in the lower part of the screen for entry of detail lines such as the details of trees found in a sample plot.
- An area to the right of the screen which is used for pop-up display windows and menus. The menus displayed here are only displayed when it is appropriate to select from them. Display windows show the detail data as it is being entered or allow the user to edit existing data. In the example above a popup menu is displayed allowing the user access to various editing functions.
- An area (in this case vacant) below the bottom border of the screen which is used to display help messages and prompts.

All FRIS database screens will have these features or a subset thereof. Placement of messages and other information will be consistent throughout the database system.

6.8 DATABASE DESIGN

While the user interface is critical to the successful introduction of a computerised system, it is only of value if the underlying program and data structure are properly designed. Designing a database for use with a Geographic Information System introduces new problems and possibilities to the database designer. Over and above any logical relationships which may exist between data in the database, the GIS allows spatial relationships and operations to be used. Whilst this introduces many new and interesting possibilities for the programmer it also means that the design must be suitable for spatial operations.

Users of FRIS will want to perform operations such as printing textual reports for all entities in a spatially designated region. Also the system must be able to check that data generated spatially (eg from API) and data input through the keyboard (eg from field books) are in agreement and can be usefully related to one another. Whilst a large amount of the programming required to perform these operations has been left to the Implementation Phase, it was essential that plans be made for the incorporation of these functions into the system in all phases of design.

The database structure for the primary data shown in Annex 7 was derived with these criteria in mind. Simplicity has been retained in preference to technical perfection and allowances have been made for cross checking and spatial integration.

6.9 GRAPHICS/DATABASE INTERACTION

Where possible, the user must be isolated from the interaction between the two software packages, the FRIS must have an identity and 'feel' of its own. The fact that MAPINFO and FOXPRO share a common data structure and the advantages this affords have already been discussed. In the fully configured FRIS, many operations will involve both spatial and database operations. For example, the user will have the ability to perform spatial operations such as selecting a region by drawing a line around it followed by a database function such as printing a report for selected data categories in that region. Alternatively, the user might perform a database operation such as a calculation of predicted dollar value of timber in a region and then use MAPINFO functions to produce a coloured or thematic map.

The user must be able to perform operations such as those above, easily, quickly and intuitively. This is achieved in FRIS by starting MAPINFO configured, ready for use, from options in the FRIS menu in FOXPRO. The two systems will communicate as the systems are swapped and transfer the information necessary for them to perform the user selected task. This transfer will be virtually transparent and the only slight inconvenience to the user will be a small delay as the programs swap.

6.10 SOFTWARE PRODUCED TO DATE

At the conclusion of the Inception Phase the following programs had been completed:

- Data maintenance procedures for the lookup tables involved in data entry and maintenance at the start of the Implementation Phase, including Species table, sample plot type, and land cover type tables;
- Data entry and maintenance for the FFS field book data;
- Reports, including Species listing, Plot type listing, Land Cover Type listing and Field book data listing;

- Entry and maintenance facilities for the SCD's alienated land boundaries and translation facilities to MAPINFO;
- Alienated Land boundaries listing report;
- Pull down menu system;
- A scrollable on screen reporting facility, and
- Facilities to call (start up) MAPINFO from the FRIS menus.

6.11 SYSTEM TESTING TO DATE

The software written to date has been 'loaded' with the data generated from the Pilot Study and rigorously tested by both the programmer and Mr Gilmour Pio. The Alienated land boundary entry program was used as a test case for the user interface, the majority of the cadastre for Guadalcanal having now been entered. Faults in the interface were detected and corrected, the lessons learnt being carried through to the other software written.

6.12 REMAINING WORK

A great deal of the detailed design of the system remains to be done, much of which will be performed progressively as the uses and requirements of the system unfold. The customisation of MAPINFO has yet to be considered and the interaction between two systems is only conceptually designed. Prior to the commencement of serious programming effort in the Implementation phase, the structure of the database, the specification of required database software and the MAPINFO customisation details need to be finalised and documented.

At the end of the Inception Phase approximately one fifth of the programming had been completed. Given that the requirements will change during the project and that these changes will require programming input it is evident that a great deal of time will be spent on the system development. This time will be well spent since the further the users (particularly casual users) can be isolated from the intricacies of the software then the more time they will have to concentrate on their work.

6.13 CONCLUSION

Although a great deal of work remains to be done before the FRIS is fully functional, it is already showing the promise of what it will be. The basic system structure and 'look and feel' have been produced, pilot data has been loaded and the system tested. In its prototype stage it has already produced maps that have been used in the field for data collection and it has been used to enter, and map, the alienated land boundaries for Guadalcanal.

CHAPTER 7

ACTIVITIES IN THE IMPLEMENTATION PHASE

7.1 ACTIVITIES

This chapter covers the activities required for the implementation of the Forest Resources Information System. The activities are divided into a series of discrete activities broadly grouped into national and regional data set creation.

7.2 NATIONAL DATA SETS

These data sets are currently available in map form or on disk for the whole of the country. It is intended that these data be captured for the whole country in the initial stages of the project and work commenced on this during the Inception Phase. This data set includes the main base map requirements of infrastructure, rivers, coastline, logging licence areas, climate and the administrative boundaries (Wards, "local areas" and provinces). These have been collected in map form and it is planned to continue digitising the data in the first quarter of 1991. It is important that this data be available by the start of the Implementation Phase to free staff and facilities for the processing data later in the Implementation Phase.

The 1986 census also forms part of the national data set. The villages will be digitised and the existing LOTUS 123 data files from the Government Statistics Office will be translated into DBASE format.

7.3 REGIONAL DATA SETS

These data sets should be processed and entered into the FRIS as the results become available from field surveys. Five broad groups of activities are involved.

(i) Processing of Data

Field data from the FFS and EEFS components will be entered into FRIS by staff from MNR. It is estimated that they will generate approximately 6000 field sheets each with up to 10 records per sheet. A similar quantity of data will be generated by the EEFS. These data will be processed after the completion of each stage of the surveys.

The land resource data set resulting from a compilation of the work of Hansell and Wall and Chase will also be entered into the FRIS to function as a library file. The timing of this work is not as critical as for the FFS and EEFS data.

(ii) Entering of Resource Boundaries

This will involve the digitising of land cover boundaries, land systems, watersheds, AOAs and information derived from remote sensing. Within Priority Area 1, the land cover information will be derived from API and transferred to 1:50000 topographic maps for digitising. A similar but less detailed procedure will be used for PA2. However in this case use will also be made remote sensing to analyse land cover types. Note that land cover includes forest types and cleared areas. PA3 will generally not be examined in the same detail.

Land systems and AOAs will be digitised from maps by Hansell and Wall.

Watersheds (also from Hansell and Wall) will be marked directly on the 1:50,000 topographic maps for digitising.

The digitising work load will be fairly constant throughout the project and will require inputs from both FD and SCD.

(iii) Slope Classification

Slopes will be classified as 0-15, 15-30 and over 30 degrees using the contours on the 1:50,000 topographic maps. The boundaries will be hand drawn and then digitised into FRIS. This work has to be completed prior to the commencement of each sub regional unit as the data is required to determine the limit of accessibility to decide the boundary of the PA1. This activity will require inputs from SCD staff during the first quarter of 1991.

(iv) Order of Work

MNR staff will be involved in the processes which are required for each completed sub regional unit, this will involve verification of data and posting to regional unit databases. At the conclusion of operations for each regional unit the data will be used for regional analysis and a report produced. It is intended that West and Central Guadalcanal, Malaita and Isabel be surveyed by September 1991 followed by Makira and South East Guadalcanal and the remainder of SI in 1992.

(v) Auxiliary Analysis

This involves the use of the FRIS system to identify POAs and to develop watershed and environmental sensitivity classifications once the field surveys and analyses for each region have been completed.

7.4 STAFFING AND MANAGEMENT ARRANGEMENTS

The staffing structure proposed for FRIS is based on the existing departmental structure and recognises the involvement of the Department of Survey and Lands, Forestry Division and Environment and Conservation Division. It is important that the FRIS be developed within the existing institutional structure if adequate SIG support is to be received during implementation and the system is to be sustainable in the long term. The joint involvement of FD and SCD in FRIS also follows the traditional working relationship between these the two Ministries as SCD provides cartographic and photogrammetric services for FD.

Neither agency presently has a functioning planning section which would normally be the location for FRIS responsibility. It is likely that FD will not develop a formal planning capability until the FRIS is in place and being used to compile sector and strategy plans. It is recommended that project management and the PCC further explore the alternatives for institutionalising FRIS during the early stages of the Implementation Phase.

Within SCD, Elison Suri presently supervises Moses Fu'ata (photogrammetry) and Joel Liha (cartography). The photogrammetry group will be providing one full time person for digitising duties (Gilmour Pio), whilst Moses Fu'ata will also be involved in RS. The cartography group will be supplying one person for digitising - Freddie Saenile who will become available on his return from UNI TECH. In the interim Andrew Wate will also be available. In addition, two as yet unidentified staff, are required to transfer air photo boundaries to 1:50000 topographic maps prior to digitising. The total full time commitment from SCD will be 4 staff under the supervision of Messrs Fuata and Liha on a regular part time basis.

Training for the purposes of FRIS development and operation will occur across all of these positions. Of the supervisory staff Gideon Boura will receive comprehensive training in systems management and operation during the implementation stage. The remaining supervisory staff will receive introductory training in FRIS.

Operating staff - Margaret Salini and her assistant EDP operator will receive training in EDP - with Margaret also receiving an introductory training to the map aspects of FRIS - mainly digitising. Gilmour Pio has already been trained to a level of proficiency in digitising and has shown a marked aptitude for GIS work. Andrew Wate will require training in the use of the digitiser. This group will be trained in the period when the data base specialist is in country. (In order to make better use of his services the remaining 6 weeks should be split into two inputs over the period January to May.). During his absence, Gilmour Pio should be able to undertake training of staff assigned to digitising.

Freddie Saenile who will be studying for a surveying degree at UNITECH, Lae in 1991 where MAPINFO training is also to be available. On Mr Saenile's return from Lae, it is the intention that he replace Mr Gilmour Pio after a suitable overlap period. SCD have indicated that they place some priority on Mr Pio also receiving advance level degree training at Lae in 1992 as well as advanced level GIS instruction.

RECOMMENDATIONS

27. That AIDAB who is sponsoring Mr Saenile's study at Lae be approached by the project to approve Mr Saenile receiving introductory level training in MAPINFO at Lae.

28. That Mr Gilmour Pio and Mrs Margaret Salini receive DOS training at SICHE as soon as possible.

29. That AIDAB consider sponsoring the training of Mr Pio in 1992 as part of this project.

30. That the middle level management staff of Gideon Boura, Moses Fa'ata and Joel Liha operate as a technical working group to coordinate the day to day activities of their various sections.

CHAPTER 8

HARDWARE AND SOFTWARE REQUIREMENTS

8.1 HARDWARE REQUIREMENTS

Hardware requirements are based largely on the volume of data to be stored and the type of processing required by the different FRIS users and system developers.

8.1.1 Data Storage Requirements

All datasets relevant to the Implementation Phase were captured over the pilot area during the Inception Phase. Many of these were extended to the full extent of the 1:50000 sheet in which the pilot area was located. An accurate nationwide estimation of the land area and associated coastal and terrain complexity of each of the 1:50,000 sheets was undertaken. This formed the basis of developing an accurate estimate of data entry times and data storage requirements for the Implementation Phase.

The total storage requirement for FRIS sizes will be approximately 100 Mbytes. Table 8.1 lists the major data sets and estimated file sizes:

Data Set	Size (Mb)	Comments
Software	20	MAPINFO,FOXPRO etc.
Base Mapping	10	From Compilation Sheets
Land Systems	9	LS boundaries and Attributes
AOAs	2	AOA boundaries and attributes
FRU	15	FRU boundaries and attributes
FFS Samples	5	Plot positions, tree attributes
Slope Data	10	Manually from 1:50,000 Topo maps
EEFS Samples	10	Environmental survey samples
Watersheds	2	Watershed boundaries and attribs
Logging Licences	2	From FD
Alienated Land	2	Entered from SCD coordinate list
Census Data	3	Attributes and village pos'ns
Flora and Fauna	2	Attributes and position
Climate	1	Rainfall and cyclone paths
System	5	System internal files
Total	98	

Table 8.1 - Data Storage Requirements

A minimum of 50% overhead should be allowed for system and user working files. Anticipating the likely user demand and growth of the FRIS, as indicated by the workshops, it is considered that the existing 300 Mb IPC 80386 machine is appropriate.

8.1.2 FRIS Development Requirements

During the Implementation phase many activities related to FRIS will occur simultaneously. At any one time FRIS computers will be being used for FRIS software development, digitising, attribute data entry, data integration (joining the map and attribute data) and data checking.

It has been estimated that a total of 350 person days will be required to complete the digitising. It is feasible to perform this digitising using a single digitising table, however it does mean that the computer attached to the digitiser will be totally dedicated to digitising for the duration of the Implementation Phase. A computer must therefore be available for the other tasks of attribute data entry, data integration and checking.

In terms of management and cost this is a far more desirable option than commissioning a second digitiser. Digitising work requires fast processing, but because the main FRIS database will be stored within the existing 300 Mb machine, storage requirements will be moderate.

The existing desktop 386 computer is appropriate for digitising.

8.1.3 Location of Data Entry

From a management point of view it is desirable that all data entry, both attribute and spatial, be performed within the one physical location. The data entry of data from different sources requires coordination, this will not be possible if the operators are not working together. In the early stages of the project it will be even more important that the relatively inexperienced operators are supervised.

8.1.4 FRIS User Requirements

The prime beneficiary of the FRIS is the FD, therefore they must have access to an inquiry system. Considering the long term size of the database, the fact that a full copy of FRIS must eventually be located in FD, it is recommended that a second 300 Mbyte 80386 computer be purchased for use within the FD. In the short term this machine may be installed in the SCD to be used for data entry.

The most cost effective way to transfer an up to date copy of the FRIS from SCD to FD is to routinely carry a copy between the offices using the existing Bernoulli transportable hard disk. This method is fast, simple and requires no extra computer hardware. Other methods considered, including Wide Area Networks (WANS) and Telekom supplied landlines are considered to be too expensive and/or complex.

As described in Chapter 6, the Environmentalist will use auxiliary analysis system which will require data from the FRIS and will in turn pass classified environmental sensitivity zones back to the FRIS for general user analysis. The environmental team will also require computing power to carry out periodic analysis with the image processing software. The ECD has recently received an 80286 computer for the Timber Control Unit (TCU) Project, it is believed that this machine will be available and suitable for the Environmental team's processing requirements.

RECOMMENDATIONS

31. That the existing 300 Mb 80386 computer be used for storage of a working copy of FRIS and for parallel FRIS development tasks.

32. That the existing 100 Mb desktop 80386 computer be dedicated to digitising for the duration of the Implementation phase.

33. That a second 300 Mb 80386 computer be purchased for FD for the purpose of storing completed portions of FRIS for enquiry purposes and data input and checking of the FFS data. This machine should be situated at SCD in the short term and later moved to the FD.

34. That the TCU 80268 computer be dedicated to the Environmental team for the purpose of developing the environmental sensitivity areas for subsequent input into the FRIS.

35. That two additional UPS power surge/failure protectors be purchased in association with the above computer.

36. That the existing Sharp PC-6200 laptop 80286 computer be dedicated to FRIS development and documentation.

8.1.5 Hardware Peripherals

The A1 Hewlett Packard pen plotter will be used to produce large working maps and verification plots. Its present location within SCD is therefore ideal for developing the mapping component of the FRIS.

The A3 Hewlett Packard PaintJet is more suited to the rapid production of high quality full colour maps. When the FD computer (Recommendation 33) is moved from SCD to FD this printer should be included as the means of producing enquiry maps.

The Cannon Bubble jet printer is a high quality printer that would be well suited to providing the textual printouts at the FD FRIS enquiry station. A second, lower cost A3 sized printer is required at the SCD for program development and reports.

The Bernoulli external disk drive is an ideal means of backing up the working copy of the FRIS and transporting the FRIS databases from SCD to FD. A further ten 44 Mbyte diskettes are required for the Implementation Phase.

RECOMMENDATIONS

37. That an Epson (or similar) wide carriage NLQ dot matrix printer be obtained for installation at SCD.

38. That a further ten 44 Mbyte Bernoulli disks be obtained for data backup.

8.1.6 Miscellaneous Consumables

During the pilot study considerable difficulty was found in purchasing consumable items for the equipment. It is thus advisable that the following items be procured out of country:

20	packets of 8 felt tipped plotting pens
5	packets of 8 metal tipped plotting pens
8	containers of refill plotting ink (8 colours)
10	Paintjet cartridges
3	Boxes of High Quality A3 colour printing paper
15	Cannon Bubble Jet Ink replacements
15	Epson Ribbon replacements
30	packets of 10 1.4Mb floppy disk drives
1000	sheets of A1 drafting paper
2000	sheets of A3 drafting paper
2	5.25 inch floppy drive cleaning kits
2	3.5 inch floppy drive cleaning kits.

8.2 SOFTWARE REQUIREMENTS

8.2.1 GIS Software Options

Very definite GIS requirements were determined during the Inception Phase. A summary of recognised GIS systems is given in Table 8.1 and observations on the GIS requirements are as follows.

i) The only well established and supportable operating system in SI is DOS.

ii) In order to store and manipulate the large amount of attribute information to be input into the FRIS, the GIS software must have a recognised database as an integral part of the system. Numerous examples of this requirement were noted, for instance, the forest volume calculations required a link between land cover mapping, field plot location and the FFS data. Other examples of datasets requiring a strong tie between spatial and database information include census, herbarium records, EEFS records, floral and faunal records, logging licences and land systems.

iii) The dominant data manipulation and analysis packages were found to be DBASE and LOTUS. SICHE has based its computer courses on these packages and produces a large number of graduates annually. Subsequently the majority of industry and government computer users have these packages. All computerised data were found to be these formats, for instance the Census data was in LOTUS format and the environmental flora and fauna records were in DBASE. FD staff have a good understanding of both systems. Unitech graduates are given a grounding in DBASE and previous New Zealand consultants have provided a number of computers together with DBASE and LOTUS software as well as basic training.

iv) The FRIS will be designed to provide a simple map/menu interface to the user which will be used to access the voluminous and more complex attribute data. The GIS software will need to have an extremely flexible modification language to create the required customised menus and to formulate new FRIS commands.

v) The digitising component needs to be easy to use yet have facilities to accurately capture base mapping and handle local re-registration where subsequent digitising does not coincide with the base mapping layer.

vi) The system will need to be maintained in country in the long term. Purchase of new software and maintenance contracts should therefore be low cost and a well established support network should be available in the region. Training should also be available from tertiary institutions within the region.

vii) Due to the remoteness of SI, computer equipment can take weeks to repair. It is unlikely that all of the FRIS computers will have problems at the one time. In contrast, there are only two primary output devices. The GIS software should have the ability to support the wide variety of printers present in SI, should problems occur.

The software used during the Inception Phase was MAPINFO. Please refer to Table 8. for a comparison between MAPINFO and three other recognised GIS systems.

In summary, MAPINFO met all of the above criteria, and in comparison to the other systems was shown to be the most appropriate for use as the graphical component of the FRIS.

One fault with MAPINFO is the need for boundaries to be digitised in full. In order to avoid this causing a backlog in the Implementation Phase, it is recommended that the land systems be digitised as single lines and additional program be purchased which converts singly digitised lines into closed boundaries.

	ERMS	MAPINFO	PC ARC/INFO	SPANS
DOS OPERATING SYSTEM	YES	YES	YES	YES
INTEGRATED ATTRIBUTE DATABASE	NO	YES	YES	YES
DATA STRUCTURE	RASTER	VECTOR	VECTOR	RASTER
COMPLEXITY OF USE	LOW	LOW	HIGH	MODERATE
CAPITAL COST RANGE	$1-2,000	$1-3,000	$10-15,000	$15-20,000
DEGREE OF CUSTOMISATION POSSIBLE	NONE	HIGH	MODERATE	LOW
UTILITY OF DIGITISING FUNCTIONS	MODERATE	MODERATE	HIGH	MODERATE
COMPLEXITY OF DIGITISING FUNCTIONS	MODERATE	LOW	COMPLEX	MODERATE
NUMBER OF OUTPUT DEVICES SUPPORTED	LOW	HIGH	HIGH	LOW
SYSTEMS WORLWIDE	< 100	10-15,000	5-10,000	<5,000
SYSTEMS IN REGION	NONE	VANUATU PNG	WESTERN SAMOA	NONE
REGIONAL TRAINING	NONE	UNITECH, LAE	NONE	NONE

Table 8.2 - Comparison of Recognised Geographic Information Systems

Another point worthy of note is that MAPINFO is a vector system and therefore processes raster data, such as remote sensing imagery, as points and boundaries rather than as pixels. This is not considered a problem because it is not the intention of the project to order significant amounts of remote sensed digital data. Instead, a number of sample images will be examined and this will form the basis of ordering hardcopy images. These images will be examined visually and areas of interest delineated and then digitised directly into FRIS. (See the working papers 3 and 5 for more details.)

RECOMMENDATIONS

39. That MAPINFO be adopted as the GIS software for FRIS because it was successfully used in the Inception Phase and because it rated favourably when compared to other recognised GIS software packages.

40. That an additional two copies of MAPINFO be purchased, one for the unit to be located in FD, and a second for the unit to be used for digitising at SCD.

41. That the additional software which creates boundaries from singly digitised lines be purchased to reduce time required for digitising.

8.2.2 Incremental Technology Transfer

ERMS is a central component of the domain analysis and modelling to be carried out by the environmental team. It will be used as an auxiliary data analysis tool to produce the environmental classifications for subsequent integration into FRIS. Its raster data structure is complementary to the vector data structure of MAPINFO and reference to Table 8.1 indicates that it is appropriate in terms of cost and ease of use.

The PC based image processing system EESIP will be employed by the API specialist and Environmentalist to determine the optimum technical specifications for ordering the hardcopy RS imagery.

A great danger exists that too much technology will be introduced and the whole concept of an easy to use FRIS be lost under a plethora of computerised sub-systems. FRIS has been designed with incremental technology transfer in mind.

Incremental technology transfer is the concept of providing technology in steps which are a logical progression from existing institutionalised skills and capacities. A key element of this approach is the development of an intuitive map based and customised access system to insulate the user from the more complex components of GIS and the database. Also operation of auxiliary systems should be restricted to those SI personnel directly involved with the data that those systems are being used to process.

RECOMMENDATION

42. In order to avoid the introduction of excessively complex technology, that ERMS and ESSIP be adopted as auxiliary analysis systems separate from the FRIS proper, and that only those personnel directly involved in using these systems be given training in their use.

8.2.3 Support Software and Standards

DBASE will be the standard data exchange format. The FRIS database will be implemented in FOXPRO, a DBASE compatible relational database manager. LOTUS (and compatibles) will be adopted as the standard spreadsheet package, again conforming to the above standard because of ease of translation into DBASE.

The DBASE programming necessary to customise the FRIS will be carried out in FOXPRO. FOXPRO was chosen for its use of DBASE files, sophistication and flexibility.

8.3 COMPUTER ACCOMMODATION

During the term of the Inception Phase, it was noted that many of the computers installed in various departments are located in poorly ventilated or dust prone areas. It is therefore not surprising that many users have reported disk failures. This is probably associated with the dust and humidity present in the SI working environments. The SOLFRIP team experienced three disk crashes during the relatively short period of the Inception Phase. It is therefore important that the computers on which FRIS will run be adequately housed at both SCD and FD. Areas have been identified at both offices which meet space requirements, however, substantial renovation will be required.

RECOMMENDATIONS

43. That the area at SCD provided for the project be enclosed, and that a "window type" air conditioning unit be installed. Ducting will be required to connect to the exhaust outlet for the existing central air conditioning system.

44. That carport area at FD be enclosed and both that area and the adjoining room assigned to the project be air conditioned with two "window type" air conditioning units. Louvre windows should be replaced with full glass windows.

CHAPTER 9

COST SUMMARY

9.1 EQUIPMENT AND CONSUMABLES

Estimated costs for FRIS are outlined below and are based on the specifications given in Chapter 8.

No.	Item	$AUS
	Hardware	
	330 Mb IPC computer with 2Mb RAM	$ 8,893
9	44 Mb Bernoulli disks	$ 1,500
1	Epson A3 dot matrix printer	$ 1,550
2	Accucard 300 VA UPS unit	$ 1,000
	Consumables as per Section 8.5	$ 3,000
	Cables and connectors	$ 200
1	External disk drive for Sharp PC 6200	$ 665
1	VGA Monitor for word processing on existing Sharp 386 SX laptop	$ 700
1	Extra 1 Mb RAM for 386 Desktop	$ 200
4	Four point power spike protectors	$ 220
1	3.5 inch diskette storage box	$ 45
1	5.25 inch diskette storage box	$ 55
6	Dust Covers (3 Computers, 2 Printers, and 1 Plotter)	$ 180
1	Small computer tool kit (screwdrivers)	$ 40
	Software	
2	MAPINFO	$ 3,000
1	Line to boundary conversion program	$ 2,000
1	FOXPRO unlimited runtime	$ 720
	Software Maintenance Contracts 2 years	$ 3,000
1	Xtree, Norton Utilities for FD machine	$ 650
1	386MAX memory manager	$ 350
	Renovations	
	SCD	$ 3,000
	Renovations FD	$ 7,500
3	15000 BTU air con	$ 4,500
	Repairs and maintenance	$15,000
Total		$57,968

Table 9.1 - Estimated Costs

9.2 AUSTRALIAN TECHNICAL ASSISTANCE

The ATA inputs outlined in Chapter 7 involves 15.5 man months of ATA input from the Geographic Information Systems Specialist, Data Base Programmer and Resource Information Coordinator.

9.3 SIG COSTS

SIG will bear the utilities and communication costs of the project as well as contribute four full time staff to the entry of data to FRIS. In addition the equivalent of one full time position in inputs will be provided by middle management staff from FD and SCD to the development of FRIS

REFERENCES

Chase, L.D.C., Preliminary guide to the suitability of land in the Solomon Islands for crops, Land Use Planning Section, Ministry of Agriculture and Lands, Honiara, 1981.

C.S.I.R.O., Pilot Study Report, Vanuatu Forest Resources Inventory, Working Paper 1, Brisbane, 1990.

Henderson, C.P. and Hancock, I.R., A guide to the useful plants of the Solomon Islands, Ministry of Agriculture and Lands, Honiara, 1988.

Hansell, J.R.F. and Wall, J.R.D., Land Resources of the Solomon Islands, Land Resource Study No 18, Land Resources Division, Ministry of Overseas Development, Surrey, 1976.

Solomon Islands Government, Socio-economic Survey of Smallholder Farming Systems in the Solomon Islands, Ministry of Agriculture and Lands, Honiara, 1989.

ANNEX 1

REVIEW OF FARMING SYSTEMS

SOCIO-ECONOMIC

SURVEY

1. INTRODUCTION

This review is based entirely on the Socio-Economic survey of smallholder farming systems in Solomon Islands (AES, RSP 1989). This survey covered the major islands and provinces and involved the survey of farmers in selected areas and the collation of data on the components of the farming system. In the context of this project, the data of direct relevance is that dealing with the cultivated farm areas under the slash and burn/cash tree cropping farming system.

The discussion that follows is based on some unproven assumptions that are required to extrapolate the socio-economic survey results nationwide. The principal assumptions are:

a) That areas surveyed are sufficiently representative to allow extrapolation. This assumption can only be tested once the FRIS is in place.

b) That the proportion of farm areas dedicated to cash tree cropping remains constant. There may be an argument to suggest that the expansion in cocoa and the coconut replantings in the last decade reflect the success of subsidy programs aimed at establishing or rejuvenating the cash crop sector.

c) That the increased gross food crop production required to sustain the population growth will not be met by significant increases in per hectare yields of food crops or by imports.

2. PRESENT DEMANDS

The food crop or food garden sector is based on slash and burn systems. Under this system, food crop gardens (dominantly root crops) are continuously cropped for up to three seasons and then fallowed as bush fallow for five to ten years. Theoretically the fallow period depends on the fertility of the specific site. Practically the fallow period is dependant on the gross area needed under crop per year to maintain production and the pragmatic farming system constraints of household labour supply. As the number of households in the area increases, the increased area of food gardens can only be obtained by increasing the continuous crop period, decreasing the fallow period or increasing the area available for the existing farming system. The latter strategy requires more labour and often involves an increase in walking distance to the food garden area as food gardens penetrate further into the forest. The large number of villages in the 1986 census with populations of less than 5 households suggests that a dispersed settlement pattern exists which acts to reduce the walking time to the food gardens.

The introduction of cash crops such as coconuts and cocoa in SI and coffee in PNG to the slash and burn farming system further increases the demand on the primary forest. Cash crops need to be as close as possible to the service infrastructure and thus displace area from the bush fallow system which must be replaced by further felling of primary forest for food gardens.

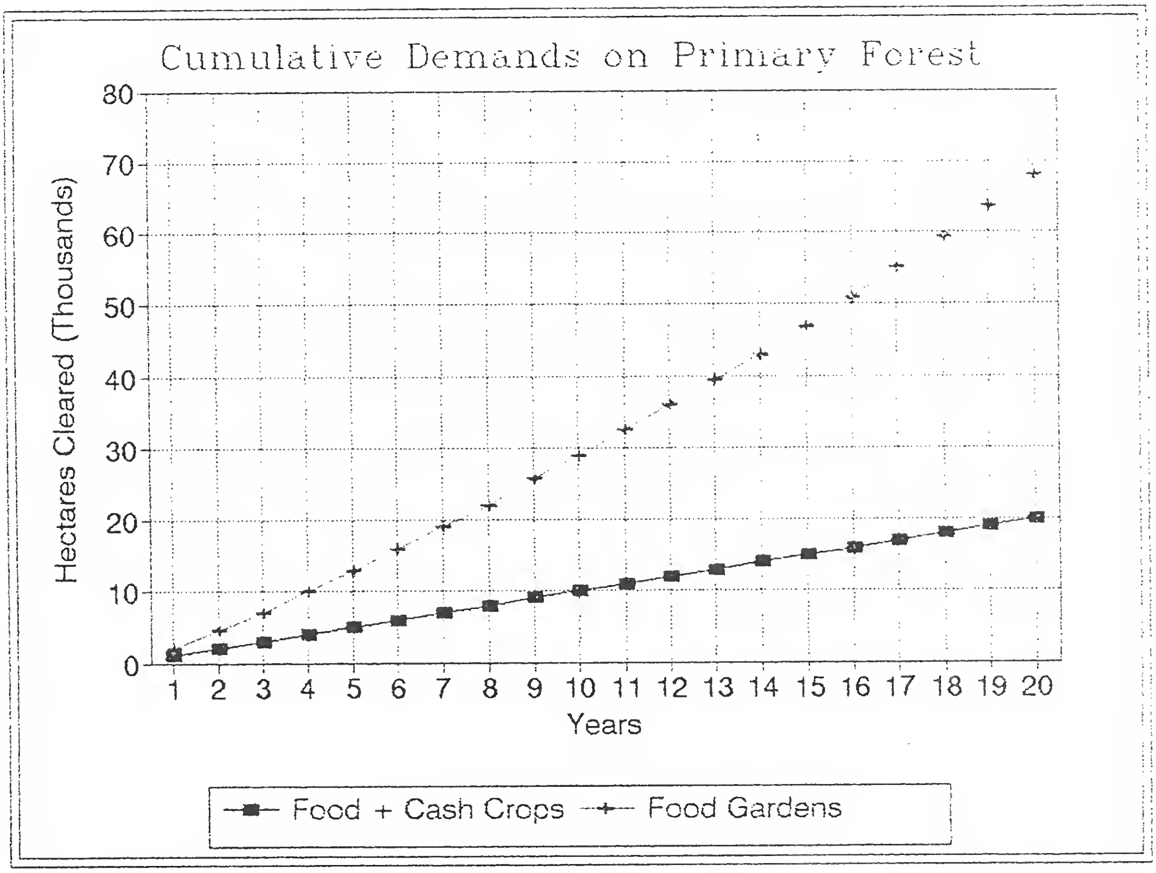
Six of the subsample areas from the socio-economic survey were covered in detail. These results are from the provinces with some 35228 rural households. The average total area under crop per household is 1.09 ha of which .84 ha is perennial tree crop. The slash and burn food crop garden averaged .24 ha, 25 percent of which was cleared from primary forest. In effect, the clearing of primary forest for food gardens has to be assumed as occurring over the period of the food crop continuous cropping. For the cash tree crop sector, approximately 35 percent of the current crop was derived from primary forest. This clearing has to be converted to an annual rate using the extent of plantings over the last 10 years.

The cumulative area cleared over the next 20 years given that the areas under gardens and cash crops expand at the current compound rate of population growth was calculated under the assumptions outlined above. The data indicates that a further 700 square kilometres will be felled by this sector in the next twenty years with a large proportion of this due to the perennial cash tree cropping.

Given that the subsistence sector demand is inevitable and that the commercial logging sector is likely to move increasingly to the customary land areas, agricultural and forestry planning should aim to ensure the integration of commercial forestry and subsistence demands on the forestry resource. This means that merchantable timber extraction should be focused on those areas where the subsistence sector will expand in the future. Extraction methods should ensure that the soil resource is not degraded for the subsequent subsistence farmers.

Summary Statistics From Socio-Economic Surveys
Forest Utilisation from Subsistence Sector

Province Area Surveyed	Isabel Susubona	Western Simbo	G'canal Avu Avu	Malaita Afio	Central Hakama	Makira NW Pen	Total
#HH in Province	2054	7405	8076	11904	2811	2978	35228
Farming System Statistics							
Present HH Farm Size (Avg)	1.6	0.89	0.8	0.54	1.31	1.39	
Present Food Garden (Avg)	0.36	0.14	0.19	0.17	0.38	0.26	
Present Cash Crop Area (Avg)	1.24	0.75	0.61	0.37	0.93	1.13	
Rotation Cycle (Years)	7	4	4	8	9	6	
Food Garden Period	3	2	2	3	3	2	
Garden from Forest %	22	11	23	23	19	50	
Tree Crop from Forest %	66	41	61	15	15	9	
Tree Crop % < 10 years	20	2	50	21	10	57	
Forest Demand - Garden/HH	0.03	0.01	0.02	0.01	0.02	0.07	
Forest Demand - Cash Crop	336	455	601	132	78	61	1664
Forest Demand - Garden	54	57	176	155	68	194	704
Annual Felling of Primary Forest	390	512	778	287	146	254	2386
Av Time to Gardens (hours)	0.4	0.3	0.5	0.6	0.3	0.5	
Av Time to Cash Crop (hours)	0.3	0.2	0.1	0.5	0.2	0.6	



Cumulative Demands on Primary Forest
Hectares Cleared (Thousands)
0
10
20
30
40
50
60
70
80
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Years
Food + Cash Crops
Food Gardens

ANNEX 2

SUMMARY OF

NON FOREST USERS OF FRIS

Listed below is a summary of the main nonforest users for FRIS that were identified during the Inception Phase. FD requirements are covered in detail in the main part of this paper and ECD requirements are covered in Working Paper 3. This summary is derived from a detailed file record of discussions held with various agencies.

ORGANISATION: Meteorological Service (MS)

DATA CATEGORY: Climate

DATA FORMATS: For 8 fully equipped meteorological stations, full data sets on disk. Also some of the earlier Agriculture Research weather station data reported in Hansell and Wall has been computerised. In addition there are annual rainfall and seasonality map-based classifications with extremely fuzzy boundaries. Detailed cyclone track maps and a recent cyclone incidence classification scheme is also available.

POTENTIAL USE REQUIREMENTS:
Data is readily available to the project. A program to install automatic solar powered stations is to commence soon and would appreciate feed back from the project on where to locate them to best advantage.

CONTACTS: Michael Ariki and Festus Amikau ph 212757 ext 229

ORGANISATION: Civil Aviation Division (CA)

DATA CATEGORY: Accurate detailed location of aerodrome facilities

DATA FORMATS: Locational data and associated strip details

POTENTIAL USE REQUIREMENTS:
None

CONTACTS: Ed Jackson, Controller CA

ORGANISATION: Herbarium, Ministry of Natural Resources

DATA CATEGORY:
1. Computerised listing of 3400 plant species by use code, common name and endemic status.
2. Computerised listing of recent accessions to Herbarium with long. and lat. locations.
3. Computerised listing of species by common and other dialect names.

DATA FORMATS: DBASE III files

POTENTIAL USE REQUIREMENTS:
Would use a computerised decode plant naming system if the project developed the DBASE files. Uses Hansell and Wall as the main reference for resource purposes and would want to access project forest typing information as well as any environmental assessments. Would use the system to maintain a map base of accession locations.

CONTACTS: David Glennie (Herbarium).

ORGANISATION: Ministry of Health and Medical Services - National Health Plan.

DATA CATEGORY: Small scale maps of Health Facilities, both government and non government sector facilities.

DATA FORMATS: Compiled hard copy statistics.

POTENTIAL USE REQUIREMENTS:
Accessing computerised population data in map form would facilitate their planning.

CONTACTS: Senior Population Planner, Abraham, Namokari, Senior Planner (Projects) Ivan Ghernu - 23600. Principal; Health Planning Officer, Mrs Joy Kere, 21666.

ORGANISATION: Government Statistics Office

DATA CATEGORY: Village location maps for the 1986 census are kept by LSD. 1986 census data at the village level in LOTUS 123 files. Non computerised pre cyclone Namu Village Resources subsample Socio-Economic Survey of small holders.

DATA FORMATS: Accurate scale correct maps and LOTUS 123 files.

POTENTIAL USE REQUIREMENTS:

Would request access to GSO statistics in map form once they have been computerised.

System would assist in the planning of future Rural Statistics surveys, the first of which is about to start.

CONTACTS: Nick Gagane 21508, Nick Dyson 23700. Rural Statistics, Paul Maccard 20068

ORGANISATION: Ministry of Agriculture and Lands. Research Division (Dodo Creek) and Land Use Planning Section (Honiara).

DATA CATEGORY:

1. Detailed results of socio-economic survey of small holders, 1989.

2. Technical information relating to farming systems and support to the Provincial Extension System.

3. Technical information on the development program for AOA's.

DATA FORMATS: Socio-economic survey results are available in LOTUS 123 files. There is a full set of hard copy reports. Full sets of Chase land/crop suitability and Hansell and Wall.

POTENTIAL USE REQUIREMENTS:

Given that H&W's and Chase's work is included in FRIS they would use the system to better plan agricultural development and extension activities in conjunction with forestry development. Access to updated land use information, population and climatic data (compared with the now dated H&W work) would be required. Access to information on the species of importance to the subsistence sector would also be important.

CONTACTS: Paul White Land Use Planning Section, Ruth Lilogula Dodo Creek Research Station.

ORGANISATION: Fisheries Division

DATA CATEGORY:

DATA FORMATS:

POTENTIAL USE REQUIREMENTS:

Use of the FRIS to identify main areas of mangroves, and other estuarine and inshore environments of importance to the fishing sector.

ANNEX 3

LAND SYSTEMS CLASSIFICATION

Land Systems are generally defined as areas with a consistent set of landform, broad geology, soils, vegetation and terrain characteristic. As they are normally mapped at scales of between 1:100000 and 1:250000 they commonly consist of associations of soils, landforms etc. These are termed land facets by Hansell and Wall - elsewhere the term land units has been used. Thus the name "land system" is used to summarise these features. In much the same way that Chase (op. cit.) derived a land suitability classification from these land systems, a variety of land stability and environmental classifications can also be derived.

This Annex covers these latter classifications which will be developed as the project is implemented. The Land Suitability Classification is well covered in the report of Chase (op. cit.)

Each of the land systems for the pilot area are described in the attached table in code form. A number of other land systems for the Guadalcanal and Florida Islands are also included as the Pilot Area contains only a few land systems. The codes used are defined below. These codes would be added to the Chase matrix of Agricultural Land Suitability Classification to ultimately form the decode file in the FRIS. The list of codes given below has been developed from a quick review of Hansell and Wall's report. Descriptive summaries of the land systems follow the codes.

GEOLOGY SUPER CLASS (GC): Refer Working Paper 3
Refer Working Paper 3 Annex 6.

Land Form Group (MG):

1 Fluvial Land Forms
- 1.1 Braided Streams
  - 1.11 Coarse bed load material
  - 1.12 Fine bed load materials
- 1.2 Terminal Deltas
- 1.3 Active Flood Plains
- 1.4 Terraces
- 1.5 Fresh Water Swamps
- 1.6 Alluvial Fans

2 Estuarine and Inshore Land Forms
- 2.1 Mangroves
- 2.2 Frontal and Foredune Systems
- 2.3 Littoral Shore Lines

3 Relict Land Forms
- 3.1 Uplifted Littoral
  - 3.11 Non Coraline
  - 3.12 Coraline
- 3.2 Dissected Lacustrine (Lakes)
- 3.3 Non Flooded Terraces

4 Volcanic Land Forms
 4.1 Plugs and Cinder Cones
 4.2 Ash Deposits
  4.21 Consolidated Deposits
  4.22 Unconsolidated Deposits
  4.23 Slip Benches

5 Tablelands
 5.1 Dissected and Ravine
 5.2 Stable

6 Ridge and Swale
 6.1 Strongly undulating
 6.2 Moderately undulating

7 Karst
 7.1 Solution Karst Plateaus
 7.2 Strongly dissected Karst

MASS WASTING HAZARDS (MW):

1 Land Slips and Slides present in forested state
 1.1 Present only in weather coast exposed areas
 1.2 Present in all areas
2 Land Slips present in anthropogenic disturbed areas
3 Not prone to slippage

EROSION HAZARDS (EH):

1 No hazards
2 Depositional Environments - no hazards
3 Erosive Flooding hazards in flat plains
4 Minor sheet and rill erosion if cleared
5 Moderate sheet rill and gully hazards if cleared
6 Baseline erosion and incision on going

FLOODING HAZARDS (FH):

1 No hazards
2 High velocity short duration flooding likely
3 Low velocity long duration flooding likely
4 Permanently flooded

DISTRIBUTION (D):

1 Restricted and of limited aerial extent
2 Common

LAND SYSTEM DESCRIPTIVE SUMMARIES

Land systems within the Pilot study area:

(1) Soto LS

This LS dominates the foothill areas and consists of moderately undulating ridge and swale landforms (MG6.2), formed from the fine grained sedimentary rocks of Late Tertiary origin (GCTP). It occurs throughout NW Guadalcanal (D12). The area is not much affected by land slips (MW3), however the steep slopes make this land system prone to erosion if cleared (EH5). Flooding is not significant.

Combined with the land suitability work of Chase and the provisional logging suitability classification, this area would be ranked as follows by FRIS output.

"Extension of agriculture into these areas is not recommended due to the low suitability for gardens and tree crops. Forest utilisation is also not recommended as the area is dominated by slopes and terrain that make logging difficult and logging would cause erosion."

(ii) Matepona LS

This land system consists of low terraces of fine textured Quaternary Alluvium (GCQA). It is very common in the major river flood plains of N Guadalcanal (D12) and is not prone to erosion (EH1) flooding (FH1) or mass wasting (MW3).

Combined with the land suitability work of Chase and the provisional logging suitability classification, this area would be ranked as follows by FRIS output.

"The area is only moderately suited to agricultural use because of soil limitations and has few major limitations to logging given that merchantable timber resources exist."

(iii) Lungga LS

This land system consists of braided stream channels of coarse gravel and rocks (MG.11) in the Quaternary alluvial plain (GCQA) and is common throughout Guadalcanal (D12). Frequent lateral changes in stream courses occur with streams migrating up to 300m. The land system is regularly flooded (FH2) but duration of floods is often short. The land system is not prone to mass wasting but is prone to erosive flooding (EH3).

Combined with the Land Suitability work of Chase and the provisional logging suitability classification, logging on this land systems should be prohibited severely or restricted as any destabilisation of the low levees will result in major changes in the hydrology and sediment transport systems to the coastal foreshore through the associated swamp land systems. (These land systems are currently being logged by Hyundai). The environmental significance of this land system and the associated Pusuraghi system requires further assessment.

(iv) Pusuraghi LS

This land system consists of freshwater swamps (MG1.5) developed behind the littoral shore line and occasionally further inland by overbank flooding from the major stream flowing through the Quaternary alluvium (GCQA). They are permanently to seasonally flooded and dependent on the stability of the main Lungga land system for their sediment and water balances. As a result they are a dynamic system with cyclical periods of contraction and expansion. They are prone to flooding (FH4) but not prone to erosion (EH1) or mass wasting (MW3).

Combined with the Land Suitability work of Chase and the provisional logging suitability classification, this land system would be ranked as follows by FRIS output.

"These areas are unsuited for all cropping other than sago foraging and are unsuited to logging."

(v) Kongga LS

This land system consists of raised strand lines (MG3.11) and broad ridges developed from Quaternary non coraline materials (GCQA) in N Guadalcanal (D12). The land system is above flood height (FH1) and not prone to erosion (EH1) or mass wasting (MW1).

Combined with the Land Suitability work of Chase and the provisional logging suitability classification, this land system would be ranked as follows by FRIS output.

"These areas are moderately suited for agriculture and would be suitable for logging given that merchantable resources exist."

(vi) Tenaru LS

This land system consists of the littoral shore and strand lines throughout Guadalcanal and contain no forestry resources.

LAND SYSTEMS OUTSIDE THE PILOT STUDY AREA:

A brief review of land systems outside the pilot area has been undertaken. As only those within the pilot area could be inspected on the ground or by remote sensing technician, a detailed assessment will have to await the Implementation Phase. In general two land systems appear to be unique.

Aleale LS on the eastern tip of Guadalcanal occupies some 500 ha and is found nowhere else in SI. This land system contains Lowland Rain Forest in a stranded lacustrine plain that has been recently dissected. The hydrology of the area is likely to be quite discrete from other systems.

Voghala LS, consisting of a single relatively intact collapsed volcanic cone on Savo Island with ash deposits on the side slopes also appears to be unique. The volcano is regarded as active with the last eruption in the middle of the last century and is in varying stages of pioneer colonisation by flora and fauna.

Kumotu LS is well developed in the sheltered estuarine areas of the Floridas and N Guadalcanal. It is the main mangrove estuarine system in the area.

None of these three land systems contain significant commercial forest resources, however they serve to indicate how the land systems content of the FRIS would provide a useful tool for environmental planning. As discussed above along with the land suitability assessments, each FRU will have a land system code attached to its attribute file.

ANNEX 4

LISTS OF TREE SPECIES

a) from Henderson and Hancock

b) Preliminary list from FRIS

The attached list contains all tree flora in the listing of Henderson and Hancock (op. cit.) for which a traditional use has been identified. Of the total species list of 3200 species, some 920 are trees of which the 250 given below have a listed use .

An additional column has been added to the list which indicates the extent to which the field teams are currently able to identify these species. Some 30 species can presently be identified from this list to the species level and if present in size ranges of >20 cm diameter will be recorded in the FFS plots. A further 110 can be identified to the generic level. The remainder pose identification problems for the FFS teams.

The Herbarium has offered to cooperate with the project in plant identification. In any case the plant identification skills of the FFS teams is likely to increase dramatically as the project progresses. However, the offer from the Herbarium to undertake identification of properly collected samples should be accepted.

Alternatively a separate field survey to cover the traditional uses of tree flora will have to be undertaken. This would represent an unjustified duplication, given that the Herbarium is able to undertake identification for the project for the FFS.

Field procedures should incorporate the collection of local names for species not identified and their identification. In order to ensure that this data is recorded, the existing 3500 species from which the attached was extracted should be modified and computerised as a reference system to allow staff to access plants in local languages, Kwaraae or by their scientific names.

The FFS forest species list has also been included.

Listing of tree flora with known uses

List excludes all agricultural species

SPECIES	STA	KWARAAE2	USES	FFS
Canarium salomonense Burtt	PT	Adoa/Andoa/Aikwasi	Fn/Cm/Tf	3
Neoscortechinia forbesii (Hook.f.) C.T.White	PT	Ai Aasila/Malako	Tl/Tf	3
Pimeleodendron amboinicum Hassk.	PT	Aisubu	Tf/Cm/M	3
Pometia pinnata Forst.f.	ET	Ako/Dawa	Te/Ff/Tl/Tc/Cw	3
Terminalia catappa L.	EC	Alita/Alite, 'Indian Almond'	Fn/O/Am/Cw/M	3
Endospermum medullosum L.S.Sm.	PT	A'asa	Te/Fm/Tl/Tf	3
Calophyllum kajewskii A.C.Sm.	PT	Ba'ula	Te/Tl/Tf	3
Terminalia brassii Exell	ET	Dafo, 'Swamp Oak'	Te/Tl/Tf/Tc	3
Kleinhovia hospita L.	ET	Fae Fae	Aw/At/Af/M	3
Vitex cofassus Reinw. ex Bl.	ET	Fata/Aiulu'ulu/Fatanaki	Te/Tc/Tl/M	3
Burckella obovata (Forst.) Pierre	PT	Fa'i Kona/Fa'i Gona/Malakona	Ff/Te/Tc/Cw/Tl	3
Teijsmanniodendron ahernianum (Merr.) Bakh.	PT	Felofelo	Cw/Tl	3
Terminalia calamansanai (Bl.) Rolfe	PT	Kako/Suali Salo	Te	3
Campnosperma brevipetiolata Volkens	ET	Ketekete	Te/Tf/Cl	3
Pterocarpus indicus Willd.	ET	Liki, 'Rose Wood'	Te/Tl/At/M	3
Buchanania arborescens (Bl.) Bl.	PT	Malakona-A./Utalaisau	Fh/Cl	3
Amoora cucullata Roxb.	PT	Maoa/Moris Ngwane	Tl/Tc/M	3
Calophyllum solomonense A.C.Sm.	PT	Ole Ole-K./Gwarogwaro	Te/Tl/Tc/Ch	3
Bischofia javanica Bl.	ET	Oli Oli	Tl/Ch/M	3
Pangium edule Reinw.	ET	Ra/Falake	Cm/Ft/M	3
Trichadenia philippinensis Merr.	PT	Sa'a/Sasa To'o/Takalofa	Tc/Cw	3
Cananga odorata (Lamk.) Hook.f. & Thoms.	ET	Sa'o Sa'o, 'Ylang-ylang'	Cm/Tl/M	3
Alstonia spectabilis R.Br.	PT	Si'iliu/Gwautasiliu'u	Tl/M	3
Alstonia scholaris (L.) R.Br.	PT	Suala/Taba'a/Aitonga	Tc/Cw/Tl/M	3
Cordia subcordata Lamk.	EC	Uaua Asi/Uwauwa Asi/Fofotasi, 'Kerosine Wood'	Te/Ct/Tl/Tf	3
Intsia bijuga (Colebr.) Kuntze	ET	U'ula	Tl/Tc/Cw/M/Tf	3
Archidendron sp. (14598/DCRS 536)	PT		Ff	2
Rhus taitensis Guill.	PT	Aakwasi/Akwasi	Cm/Tf	2
Endospermum formicarum Becc.	PT	Ai Aofia	Aw/M	2
Elaeocarpus floridanus Hemsl.	PT	Ai Enda	Tl/Tf/M/Tc	2
Hernandia moerenhoutiana Guill. ssp. samoensis	ET	Ai Hau'o	Tc/Cm/Tf	2
Archidendron solomonense Hemsl.	PT	Ai Uka/Aifae	Tl/Am	2
Myristica aff. globosa Warb.	PT	Aiba'asi	Fm/Cm/Tf	2
Diospyros insularis Bakh.	PT	Aibulu	Tf/Tl	2
Eugenia buettneriana Schum.	PT	Aibu/Aimela/(Mala) Malarufa	Te/Tl/Tf	2
Dysoxylum aff. gaudichaudianum (Juss.) Miq.	PT	Aidongadonga	Tl/Cw/Tf	2
Eugenia nutans Schum.	PT	Aifau/U'uinialakau/Duduru Usu	Fm/Tf/Tl/M	2
Inocarpus fagiferus (Park.) Fosb.	ET	Ailali	Fs	2
Ficus gul Ltb. & Schum.	PT	Aimomote/Raumomote	Cm/Tf	2
Ficus profusa Corner	PT	Aimomote/Raumomote/(Fa'i) Mangomango	Cr/Ch/Tf	2
Cryptocarya invasiorum Kost.	PT	Ainikini	Tl/Am	2
Spondias cyatherea Sonn.	ET	Aioo/U'uli, 'Hog Plum'	Ff/M/Tc	2
Dysoxylum sp. (DCRS 430)	PT	Airande	Tl/Tf	2
Elaeocarpus salomonensis Kunth	PT	Aisiko	Te/Am	2
Syzygium decipiens (Koord. & Val.) Amsh.	PT	Aisirufarufa	Te/Tc/Tl/Tf	2
Ficus erythrosperma Miq.	PT	Aitea	Tf/Cw	2
Cerbera floribunda Schum.	ET	Aitongatonga	Cw	2
Dendrocnide rechingeri (Winkl.) Chew	PT	Akoako	Cl/Fh/Am/Cm	2
Ficus adenosperma Miq.	PT	Alangia	M/Tf/Cm	2
Terminalia kaernbachii Warb.	PT	Alita Fasia, 'Almond'	Fn/Am	2
Terminalia sepicana Diels	PT	Amafau	Ff/Tc/Tl/Te	2
Ficus copiosa Steud.	ET	Amau/Sakwari	Fv/Tf/Am/Cr	2
Horsfieldia spicata (Roxb.) Sinclair	PT	Ambuino-K./Kokotetebina	Fm	2
Ficus septica Burm.f.	PT	Angalu	M/Tf	2
Gmelina moluccana (Bl.) Baker	ET	Arakoko	Tc/Te/Tl/Cw	2
Mangifera indica L.	EC	Asai, 'Mango'	Ff	2
Ficus xylosycia ssp. cylindricarpa Diels	PT	Baolafau	Fm/Cm/Tl	2
Ficus benjamina L. var nuda (Miq.) Braith.	PT	Baolagaragara	Tl/Cr/Cm/M	2
Euodia solomonensis Merr. & Perry	PT	Ba'aba'a-K.	M	2
Hernandia peltata Meissn.	ET	Bilubilu Asi/Fa'o-K./Fao Alasi-A.	Tc/M/Cm	2
Trema orientalis (L.) Bl.	ET	Bulasisi/Fifikulu, 'Poison Peach'	Aw/M/Cm/Tf/Tl	2
Canarium asperum Benth.	ST	Bulungali/Malangali	Tf/Cm	2
Macaranga aleuritoides Muell.	PT	Bura-A./Tanga Fino/Finofino	Aw/Tl/Cl/Tf/M	2
Commersonia bartramia (L.) Merr.	ET	Dadame-E./Daedae-W.	Cr/Ch/Tl/Tf/M	2
Dysoxylum arborescens Miq.	PT	Dauraegeobala-A./Sasadili/Aisisdiodioro	Tl/Cw	2
Ficus longibracteata Corner	PT	Dedela/Aidadala	Cr/Cl/Fv	2
Syzygium cinctum Merr. & Perry	PT	Dilomate	Tf/Tl/Cm	2

Eugenia clusiifolia (A.Gray) Muell.	PT	Aibu Asi	Tf/Tl/Fm/Cm	1
Anacolosa papuana Schellenb.	PT	Aidolo-K./Bota'au	Tl/Tf	1
Antidesma olivaceum Schum.	PT	Aidori-K./Mala Iru/Boborama	Fm/Tl/Cw	1
Bridelia penangiana Hook.f.	ET	Aidori/Mala Iru/Boborama	Tf	1
Micromelum minutum (Forst.) Seem.	ET	Aifali/Molakwaena-A./Aifao	Tl/Cw	1
Xylopia papuana Diels	PT	Aika'o	Tl/Tf	1
Ochrosia elliptica Labill.	ET	Aikikiru/Aimalua	Fm/Cw/Cl/Tf	1
Stemonurus ammui (Kan.) Sleum.	ET	Aikunu	Tl/Tf/Cw	1
Phaleria perrotettiana (Decne.) Vill.	PT	Ailako/Ai Andino	Cw/Tl/Cr	1
Saurauia novo-guineensis Scheff.	PT	Aimamala	Tf	1
Saurauia purgans Burtt	PT	Aimamala	Tf	1
Prunus schlechteri (Koehne.) Kalkman	PT	Aimangelo	Tl/Tf/Cw	1
Melicope grandifolia Burtt	PT	Aingwafila	Tl/M	1
Tarenna sambiciana (Forst.) Durand	ET	Aingwane	Tl/Tf	1
Xanthostemon sp. (4010)	PT	Ainigao	Tl/Cw	1
Mallotus ricinoides (Pers.) Muell.Arg.	PT	Airafu/Suamango Kwao	Tf/M	1
Harpullia arborea (Bl.) Radlk.	PT	Aisafu/Ai Uka Dolo	At/Cw	1
Aporosa papuana Pax & Hoffm.	PT	Aisalinga	Tl/Tf	1
Belliolum haplopus (Burtt) A.C.Sm.	PT	Aisi Gwarigwari	Tl/Tf/Am	1
Excoecaria agallocha L.	ET	Aisisiu	At/M/Cm	1
Gironniera celtidifolia Gaud.	ET	Aisulia	Tl/Cw	1
Phyllanthus choristylus Diels	PT	Aitafitafi	Tl	1
Finschia waterhousiana Burtt	PT	Akama	Fn/Cw/Tl/M	1
Acalypha grandis Benth.	ET	Alabusi	Aw/At/Cw/Tf/M	1
Rapanea salomonensis C.T.White	PT	Alasi/Aulasi	Tl/Cw	1
Litsea collina Moore	PT	Arisbola	Tf/Tl	1
Ormocarpum orientale (Spreng.) Merr.	ET	Aro	As/Am/At	1
Mangifera minor Bl.	ET	Asai	Ff/Cw/Tf/M	1
Artocarpus altilis (Park.) Fosb.	EC	Baleo/Rauai/Kekene-A, 'Breadfruit'	Fs/Tc/Cr	1
Ficus glandulifera Summerh.	PT	Baola	Fm/Tl	1
Polyscias filicifolia (L.Moore) Bail.	E	Berobero/Bebero	Md	1
Polyscias scutellaria (Burm.f.) Fosb.	ET	Berobero/Bebero	Fv/O/M	1
Leea indica (Burm.f.) Merr.	ET	Borabora/Borabora (Ngwane)	M	1
Fagraea gracilipes A.Gray	ET	Bou	Tl/Cw	1
Sonneratia alba J.E.Sm.	ET	Bubula	M/Tf/Tl/Cm	1
Trema aspera Bl.	P	Bulasisi, 'Poison Peach'	Aw	1
Gnetum costatum Schum.	PT	Dae	Fv/Cr/Tl/M	1
Gnetum gnemon L.	ET	Dae Fasia/Dae Malefo	Fv/Cr/Am/Tl/M	1
Calophyllum inophyllum L.	ET	Dalo	Tc/Cm/Cw/Fm	1
Morinda citrifolia L.	ET	Dilo-K./Kikiri-A.	Ff/Tl/Tf/Ch/M	1
Bruguiera parviflora (Roxb.) W. & A. ex Griff.	PT	Dina Asi/Mabura	Fm/Tl	1
Lumnitzera littorea (Jack.) Voigt	ET	Dingale Asi	Tl/Cw	1
Actinodaphne multiflora Benth.	PT	Du'ugwau	Tf/Cm/Tl	1
Barringtonia sp. (DCRS 492)	PT	Fala Alealea	Fn	1
Barringtonia araiorhachis Merr. & Perry	PT	Fala Kwasi, 'Cut Nut'	At	1
Barringtonia salomonensis Rech.	PC	Falanganda/Futu	Fn	1
Barringtonia racemosa (L.) Spreng.	ET	Falanganda/Futu	At/M	1
Barringtonia aff. edulis Seem.	PT	Fala/Aikenu	Fn/Am/M	1
Barringtonia edulis Seem.	EC	Fala/Aikenu, 'Cut Nut'	Fn/Am/M	1
Barringtonia niedenzuana (Schum.) Kunth	PC	Fala/Aikenu, 'Cut Nut'	Fn	1
Barringtonia novae-hyberniae Ltb.	PC	Fala/Aikenu, 'Cut Nut'	Fn/Am/M	1
Barringtonia oblongifolia Kunth	PC	Fala/Aikenu, 'Cut Nut'	Fn	1
Barringtonia procera (Miers) Kunth	PC	Fala/Aikenu, 'Cut Nut'	Fn	1
Callicarpa pentandra Roxb.	PT	Fa'i Isu	Tf/Tl	1
Thespesia populnea (L.) Sol. ex Correa	ET	Fa'ola Asi/Faoni Asi	Cw/Cl/Cm	1
Perrottetia alpestris (Bl.) Loes. ssp. moluccana	PT	Fi'i Fa'amela	Tl/Cw/Tf	1
Premna corymbosa (Burm.f.) R. & W.	ET	Fi'i Kwa'u	At/Tl/M	1
Colona velutina Merr. & Perry	PT	Fotefote	Tl	1
Barringtonia asiatica (L.) Kurz	ET	Fu'u, 'Fish Poison Tree'	Cm	1
Claoxylon microcarpum A.Shaw	PT	Guru Ako	Tf/Cm	1
Claoxylon aff. indicum (DCRS 203)	ET	Guru Ofenga	Fv	1
Corynocarpus cribbeanus (F.M.Bail.) L.S.Sm.	ET	Ibo Kwao/Ibo Meo	Ff	1
Rhizophora stylosa Griff.	ET	Kakabara/Tongbua/Torrbua/(Mala) Malako'a	Tl/Tf	1
Schleinitzia novo-guineensis (Warb.) Verdc.	ET	Karefo	At/Tf/Tl/Ft	1
Melochia umbellata (Houtt.) Stapf	ET	Kasie Buiu	Tl/Cr/Tf	1
Mammea odoratus (Raf.) Kost.	ET	Kokobelau, 'Mammey Apple'	Cw/Tl	1
Rhizophora mucronata Lamk.	ET	Ko'a	Cw/Tf	1
Bruguiera gymnorrhiza (L.) Lamk.	ET	Ko'a Ania/Ko'a	Fv	1
Rhizophora apiculata Bl.	ET	Ko'a Ngwane/Kakabara/(Mala) Malako'a/Ngwangwani	Tl/Fm/Tf	1
Gnetum latifolium Bl.	PT	Kwalo Uku	Fv/Cr/Ch/Cm	1
Alphitonia incana (Roxb.) T.& B. ex Kurz	PT	Kwansia/Kwana Sia	Tl/Tf/M	1
Leucosyke salomonensis Unruh.	PT	Laelae	M/Cm	1
Xylocarpus granatum Koen.	ET	Lalato	Tl/Fm/Tf	1
Eriandra fragans Royen & Steenis	ET	Leli/Beumbeu/Surau'u (?)	Fm/Ff	1

Podocarpus sp. (DCRS 370)	PT	Dingale Fau	Cw/Tf	2
Podocarpus insularis L.	PT	Dingale Tolo	Tl/Cm	2
Syzgium aff. aqueum (Burm.f.) Alston	PT	Dururu Usu	Fm/Tl/Tf	2
Albizia falcataria (L.) Fosb.	ET	Fai/Folo Fai	At/Tf/Ch/Am	2
Neonauclea aff. brassii Merr. & Perry	PT	Fa'i Bulu'a	Cw/Tl	2
Planchonella linggensis (Burck.) Pierre	ET	Fa'i Riru	Cw/Tf/Am/Tl	2
Sararanga sinuosa Hemsl.	PT	Fi'i Fautolo	Ch/Cr/Cl	2
Sterculia parkinsonii Muell.	PT	Gwa'u Gwa'u	Cw/Fm	2
Myristica fatua var. papuana Houtt.	PT	Kakala'a	Cm	2
Calophyllum cerasiferum Vesque.	ET	Kaumanu	Tl/Cw/Tf	2
Agathis macrophylla (Lindl.) Mast.	PT	Kauri	Te/Cm	2
Macaranga whitmorei A.Shaw	PT	Kokokwa'e-W./Biula-E.	Tl/Tf/M/Cl	2
Semecarpus brachystachya Merr. & Perry	PT	Kwailasi Ra'u	Cl/Fm	2
Semecarpus forstenii Bl.	PT	Kwailasi Ra'u	Cl/Fm	2
Ficus aff. solomonensis Rech.	PT	Kwalo Di'u	Cl/Tf/M	2
Abroma augusta (L.) Willd.	PT	Kwasikwasi	Ch/Cr	2
Garcinia aff. platyphylla A.C.Sm.	PT	Kwa'efanefane/Koafanefane	Tl/Am/Cw	2
Archidendron oblongum (Hemsl.) de Wit	ST	Lami Lami	Tf/Tl/Tc	2
Ficus hombroniana Corner	PT	Lasi/Bubulia/La'ua/Ragini	Cm	2
Dysoxylum aff. pettigrewianum F.M.Bail.	PT	Lato Futa-W.	Cw/Tl	2
Planchonella keyensis Lamk.	PT	Lilibaiko/Ainunura	M/O	2
Garcinia scaphopetala Burtt	PT	Lolofia	Tl/Cw/Tf	2
Eugenia sp. (2677/3984)	PT	Mala Afio	Ff/Cm/Tf/Tl	2
Mangifera mucronulata Bl.	ET	Mala Asai	Ff/Te	2
Gmelina lepidota Scheff.	PT	Maladala	Tc/M	2
Burckella aff. obovata (Forst.) Pierre	PT	Malakona	Ff	2
Neonauclea sp. (3888/4100/19144)	PT	Malanunu	Te/Tl	2
Ficus edelfeltii ssp. bougainvillei King	PT	Malifu	Fv/Tf/M	2
Planchonella macropoda Lamk.	PT	Maliolo/Fa'i Baru	Te/Tl/Tf	2
Palaquium erythrospermum Lamk.	PT	Maliolo/Fa'i Baru	Te/Tc/Tl/Ft	2
Palaquium masuui Royen	PT	Maliolo/Fa'i Baru	Tc/Te/Tl	2
Securinega flexuosa Muell.Arg.	ET	Mamufu'a	Tl/Am/Tf/M	2
Euodia elleryana Muell.	PT	Mamu-K./Bala Fasima-E./Balanikwaru-W./Ba'aba'a/Aisafu-A.	Tc/M	2
Dillenia crenata (A.C.Sm.) Hoogl.	PT	Mudi	Te/Tl/Tf/At	2
Dillenia ingens Burtt	PT	Mudu/Raorao	Te/Cl/Tl	2
Planchonella obovoidea (Burck.) Lamk.	ET	Mumu	Cm/Tf/Tl/Ft	2
Planchonella obovata (R.Br.) Pierre	PT	Ngiduiafa/Tala	Tf/Cw	2
Ficus wassa Roxb.	PT	Ngo'ongo'o	Fv/Tf	2
Dendrocnide longifolia Chew	PT	Nunulafa-E./Butailo-W.	Fv	2
Calophyllum soulattri Burm.f.	E	Ole Ole-K./Kaumanu Bala-A.	Te/Tl	2
Heritiera aff. littoralis Ait.	PT	One One	Cm	2
Planchonella firma (Miq.) Dub.	PT	Oora/Ororo/Maliolo/Fa'i Baru	Te/Tl/Tf	2
Parartocarpus venenosa (Zoll. & Mor.) Becc.	PT	Rakwan/Rakwana	Ft	2
Ficus erinobotrya ssp. solomonensis Corner	PT	Raranga	Cm	2
Ficus theophrastoides ssp. angustifolia Seem.	ET	Raurauketa Ngwane	Cm/Tf	2
Macaranga tanarius (L.) Muell. Arg.	ET	Rebareba/Taksui	Tl/Tf/M/Cl	2
Euodia aff. anisodora (5415/DCRS 48)	PT	Rii	Cm/M	2
Dolichandrone spathacea (L.f.) Schum.	ET	Ririko/Kwa'ekwa'e Ale	Tc/Tf	2
Symplocos cochinchinensis (Lour.) S.Moore	ET	Rubu Rubu	Ch/Tl	2
Aglaia argentea Bl.	PT	Saebala	Tl/Cw	2
Parinari glaberrima (Hassk.) Hassk.	ET	Saia	Ch/Tl/M	2
Ficus variegata Bl.	PT	Sala	Cm/Cr/Ft	2
Ficus sp. (DCRS 447)	PT	Samota	Cm/Tf	2
Ficus storckii Seem.	ET	Samota/Raranga Dada/Soru	Am/Fv	2
Macaranga similis Pax & Hoffm.	PT	Suamango	Tl/Cl/Tf/Cm	2
Cerbera manghas L.	ET	Totongwala	Cw/M	2
Terminalia solomonensis Exell	PT	To'oma	Ff/Tl/Tc	2
Dysoxylum confertiflorum Merr. & Perry	PT	Ulukwalo	Tl/Tf	2
Aglaia goebeliana Warb.	PT	Ulukwalo Bala/Ulukwalo Ambu	Tl/Tf/Cw	2
Artocarpus vriesianus Miq. var. refractus	PT	U'ufi	Tl/Cm/Cw/M	2
Kingiodendron alternifolium (Elmer) Merr. & Rolfe	PT	(Fa'i) Dada	Cw	2
Macaranga faiketo Whitmore	PT	(Fa'i) Keto	Tl/Tf/Cm/M	2
Sterculia fanaiho Setch.	PT	(Fa'i) Lofa	Am/At/Cl	2
Elaeocarpus sphaericus (Gaertn.) Schum.	ET	(Fa'i) Milo	Te/Tc/Tm/Tf	2
Hibiscus tiliaceus L.	ET	(Fi'i) Fa'ola-W./Fa'alo-E./Fakasu	Aw/At/Cr/Tf/M	2
Anthocarapa nitidula (Benth.) Penn. ex Mabb.	PT		Ti/Tf	1
Piper aduncum L.	ET		Tf/O	1
Acacia sp. (DCRS 548)	ET		Am/Tf/Tl/Cm	1
Crateva religiosa Forst.f.	PT	Ai Abu	M/Cm/O	1
Gomphandra montana (Schell.) Sleum.	PT	Ai Alo	Tl/Tf	1
Merrilliodendron megacarpum (Hemsl.) Sleum.	PT	Ai Ibo/Aiembu	Tl/Tf/M	1
Pittosporum ferrugineum Ait.	ET	Ai Ofa	Tl/Tf/M	1
Pongamia pinnata (L.) Pierre	ET	Ai Uka Ria/Fa'i Aia/Mala Ula/Aimarako	M	1
Psychotria capitulifera Merr. & Perry	PT	Aibosbos	Fv/At	1

Memecylon aff. vitiense A.Gray	ET	Lilia, 'Shacklewood'	Tl/Cw/Tf	1
Croton pusilliflorus Croizat	PT	Madakware'a	Tf	1
Medusanthera laxiflora (Miers) Howard	ET	Maemae-K./Ai Alo-A.	Tl	1
Geniostoma rupestris J.R. & G.Forst.	ET	Mafusifusi	Fv/Tf	1
Casuarina papuana S.Moore	PT	Malasalu	Tl	1
Drypetes lasiogynoides Pax & Hoffm.	PT	Malasata	Tl/Cw	1
Alangium javanicum (Bl.) Wang	PT	Mamalade	Tl/Tf	1
Dracaena angustifolia Roxb.	PT	Mamaladili	At/M	1
Serianthes ebudanum Fosb.	PT	Mamufai	Tc/Tf	1
Canarium vulgare Leenh.	EC	Ngali, 'Ngali Nut, Java Almond'	Fn/Tc/Am	1
Canarium indicum L.	EC	Ngali, 'Ngali Nut'	Fn/Tc/Tf/Fm/M	1
Kopsia flavida Bl.	EH	Ngangasi Baba	O	1
Fagraea racemosa Jack. ex Wall.	PT	Ngara	At/Cw	1
Pouteria maclayana (Muell.) Baehni.	PT	Ngiduiafa/Tala	Ft/Tl/Tf	1
Osmoxylon novo-guineensis (Scheff.) Becc.	PT	Ngwalifunu Ngwane/Gwalifunu	M	1
Caldcluvia celebica (Bl.) Miq.	PT	Ngwangalau	Cw/Tf/Tl	1
Pisonia grandis R.Br.	ET	Rafarafa	Fv/O/At	1
Erythrina variegata L.	ET	Rara	At/Am/Cm/M	1
Quassia indica (Gaertn.) Nooteboom	PT	Saeli'i	M/Cw	1
Neuburgia corynocarpa (A.Gray) Leenh.	ET	Safusafu/Savosavo	Tl/Tf	1
Timonius timon (Spreng.) Merr.	ET	Sakosia	M/Tf/Tl	1
Casuarina equisetifolia J.R. & G.Forst.	EC	Salu, 'South Sea Ironwood'	At/Tf/Tl/M/O	1
Cleidion spiciflorum (Burm.f.) Merr.	PT	Saola	Cm/Am/Tf/M	1
Claoxylon tumidum J.J.Sm.	PT	Saola Kwasi	Fv/Tl/Tf/Am	1
Litsea guppyi (Muell.) Muell. ex Forman	PT	Sarufi Bala	Tl/Tf	1
Phyllanthus ciccoides Muell.Arg.	PT	Sasale-K.	Am/Tf/Cm	1
Breynia cernua (Poir.) Muell.Arg.	PT	Sasale/Tata'i-K.	Am/Tf	1
Litsea timoriana Span.	PT	Sasasu/Gara Gara-E.	Tl/Tf	1
Schefflera stahliana (Harms) Frodin	PT	Sigoria	Cl/Tf	1
Homalanthus trivalvis A.Shaw	PT	Sikima/Nunumba	Aw/Tf/Ch	1
Macaranga urophylla Pax & Hoffm.	PT	Suamango	Aw/Tl/Cl/Tf/Cm	1
Aceratium insulare A.C.Sm.	PT	Surau'u	Tl/Fm	1
Gynotroches axillaris Bl.	ET	Susura	Tl	1
Pagiantha koroana var. salomonensis Mgf.	PT	Tabana-E./Malarakona-W.	Tf/M	1
Ixora solomonensium Bremek.	PT	Tabeo	Tl/Cm/Am/Tf	1
Carica papaya L.	EC	Takafo, 'Pawpaw'	Ff/M/Am/Cl	1
Adenanthera pavonina L.	ET	Tatarabebe, 'Red Bead Tree'	O/Tf/Tl/Cm/M	1
Ceriops tagal (Pers.) C.B.Rob.	ET	Tongbua	Tl/Tf	1
Cordia aspera Forst.f.	ET	Uaua/Uwauwa	Ch/Cm/Tf	1
Steganthera salomonensis (Hemsl.) Philipson	PT	U'uinialakau	Cw	1
Aleurites moluccana (L.) Willd.	E	'Candlenut Tree'	O	1
Canthium cymigerum (Val.) Burtt	PT	(Ai) Nono'o	Ct/Tl/M	1
Trichospermum psilocladum Merr. & Perry	PT	(Fa'i) Mala'o	Cr/Ch/Tl/Tf	1
Glochidion aff. ramiflorum J.R. & G.Forst.	PT	(Fa'i) O'a	Tl/M/Tf	1
Trichospermum kajewskii Merr. & Perry	PT	(Fa'i_ Sula	Cr/Ch/Tl/Tf	1
Haplolobus floribundus (Schum.) Lamk.	ET	(Mala) Mala Adoa	Fs/Tl/Tf/Tc	1
Heritiera littoralis Ait.	PT	One One II/One One I	Cw/Tf/M/Fm	

FFS = 3 These will be recorded at each FSS plot to species level

2 These will be recorded to genera level

1 These unlikely to be recorded

Uses Refer Henderson and Hancock

Status Status refers to endemic status. Refer Henderson and Hancock

SOLFRIS - SPECIES LISTING BY CODE

Date : 23/02/91

Species Code	Species Name	Merchantable	Use	Average Form Factor
1	AGLAIA SPP	.		0.0
2	ALBIZZIA SPP	.		0.0
3	ALSTONIA SCHOLARIS	.		0.0
4	ALSTONIA SPECTABILIS	.		0.0
5	AMOORA SPP	.		0.0
6	BURCKELA	.		0.0
7	CALOPHYLLUM KAJ	.		0.0
8	CALOPHYLLUM OTHERS	.		0.0
9	CANANGA	.		0.0
10	CANARIUM SPP	.		0.0
11	CELTIS	.		0.0
12	CERBERA	.		0.0
13	COMMERSONIA	.		0.0
14	CRYPTOCARYA DENDROCNIDA	.		0.0
15	DILLENIA	.		0.0
16	DIOSPYROS	.		0.0
17	ELAEOCARPUS SPP	.		0.0
18	ENDOSPERMUM	.		0.0
19	EUGENIA	.		0.0
20	EVODIA	.		0.0
21	FICUS	.		0.0
22	FINSCHIA	.		0.0
23	GARCINIA	.		0.0
24	GMELINA	.		0.0
25	GONOYSTYLUS	.		0.0
26	HERNANDIA	.		0.0
27	HOMALIUM	.		0.0
28	HORSFIELDIA	.		0.0
29	INOCARPUS	.		0.0
30	LITSEA	.		0.0
31	MACARRANGA	.		0.0
32	MARANTHES	.		0.0
33	MASTIXIODEMDRON	.		0.0
34	MYRISTICA	.		0.0
35	NAUCLEA	.		0.0
36	NEONAUCLEA	.		0.0
37	NEOSCORTECHINIA	.		0.0
38	OCTOMELES	.		0.0
39	PALAQUIIUM	.		0.0
40	PANGIUM	.		0.0
41	PARINARI	.		0.0
42	PIMILEODENDRON	.		0.0
43	PLANCHONIA	.		0.0
44	POLYALTHA	.		0.0
45	POMETIA PINN	.		0.0
46	PROTIUM	.		0.0
47	PTEROCARPUS	.		0.0
48	RHUS	.		0.0
49	SCHEFFLERA	.		0.0
50	SCHIZOMERIA SPP	.		0.0
51	SECURINEGGA	.		0.0
52	SEMECARPUS	.		0.0

Species Code	Species Name	Merchantable	Use	Average Form Factor
53	STERCULIA	.		0.0
54	SYPHONODON	.		0.0
55	SYZYGIUM	.		0.0
56	TERMINALIA BRASSII	.		0.0
57	TERMINALIA OTHERS	.		0.0
58	TEYMANNIO DENDRON	.		0.0
59	TRICHOSPERMUM	.		0.0
60	VITEX	.		0.0
61	MISC	.		0.0
62	PLANCHONNEILA	.		0.0
63	DYSORYLON	.		0.0

ANNEX 5

PLOT STUDY REPORT WITH REFERENCE TO FRIS

INTRODUCTION

DATA CAPTURE AND TRAINING

DATA PROCESSING

FRIS DESIGN

OUTPUT

EXAMPLE OF MAP OUTPUT

EXAMPLE OF TEXT OUTPUT

INTRODUCTION

The pilot study proved to be extremely useful for resolving issues of user requirements, hardware and software needs and Implementation Phase manning. Ultimately it resulted in a design for FRIS which incorporates facilities for input, analysis and output of data relating to timber and non-timber values of the forest.

DATA CAPTURE AND TRAINING

A significant portion of the initial time was spent training Mr Gilmour Pio in the basics of GIS, system management and digitising. Although this was a time consuming process, it proved to be very worthwhile over the course of the Inception Phase.

After some initial training, Mr Pio was dedicated fulltime to digitising. Datasets of significant range and size were captured, which in turn allowed accurate estimates of storage requirements and capture times to be made for the national datasets.

Mr Pio showed a remarkable aptitude for the work and his enthusiasm did not wane for the period of the inception phase. Data capture for use in the Implementation Phase was well under way by the conclusion of the Inception Phase. Digitising will continue prior to the Implementation Phase, and it is expected that most of the national data will be captured before the project resumes.

Ms Margaret Salini of the FD entered all of the data resulting from the FFS over the pilot area. Although the data was input directly into DBASE with no input validation the data was virtually error free. This task was completed in only a few days, which considering the amount of data entered (approximately 2500 records), was a remarkable achievement.

DATA PROCESSING

Considerable research was applied to the problem of using FRIS to calculate timber volume statistics. It was proved that use of the GIS could significantly reduce the number of potential errors in calculating volumes. Integrity checks were made by comparing data collected from the field (FFS data) with that gained through API. This was only possible because of the spatial operations provided by the GIS component of FRIS.

The data integration capability of FRIS facilitated communication between the FIS, API and Environmental specialists which led to more efficient procedures and a more realistic Implementation Phase manning schedule. As an example of a more efficient procedure that was developed, the API specialist developed a simple land cover type code with which to label strata derived from aerial photographs. This code was input directly into FRIS where a "look up" table was used to expand it out to a full land cover description.

FRIS DESIGN

The large volume of data input into the system also allowed the development of realistic testing of the database design and the definition of the basic unit of the inventory, the Forest Resource Unit (FRU). The definition of the FRU as a simple non-divisible spatial unit defined by relatively few variables (land cover, broad slope classes and the 400m contour) through which other layers of data (rainfall, cadastre, geology etc) was seen as the most effective way of utilising the facilities present in modern GIS packages.

Field visits and ground truthing were carried out to ensure that assumptions made in the office were valid. This process involved constant communication with other team members.

Interest in a layer of slope boundaries was widespread: the Forest Utilisation Specialist wanted to determine broad plantation opportunity areas and the Environmentalist will use them to assist in the determination of environmental sensitivity areas. A series of spot heights was collected over the pilot area and a Digital Terrain Model (DTM) constructed.

It was determined that the collection of sufficient spot heights to give useful slope boundaries would be slower than manually interpreting the contours and then digitising the resulting slope boundaries. The latter approach has the advantages of being possible in country at low cost and the disadvantage of not providing aspect or elevation information. It was decided to use the manual approach.

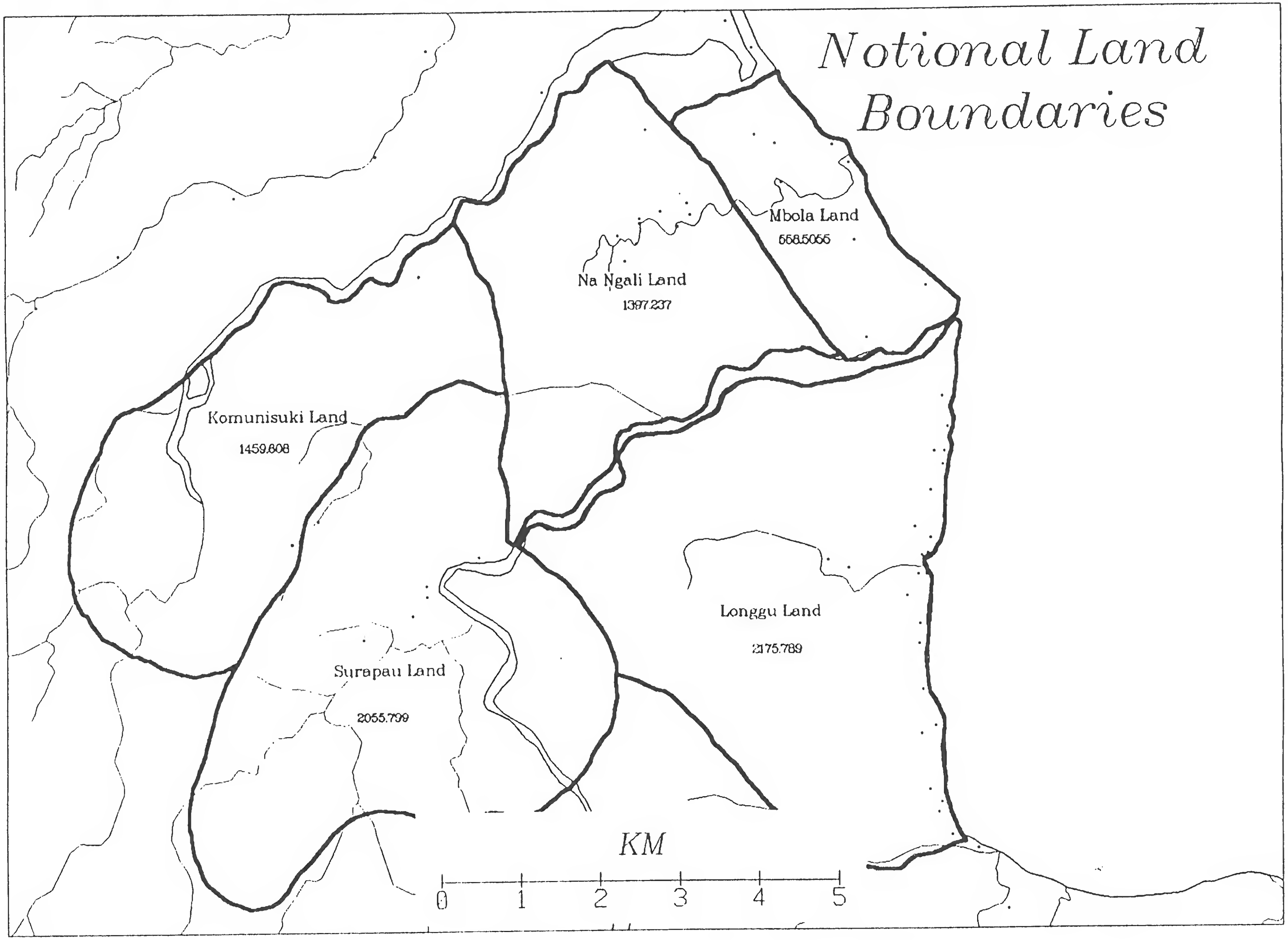
OUTPUT

The range and volume of data collected over the pilot area allowed the production of a number of colour maps for the other specialists on the team. For example, the sociologist was provided with maps showing village locations and populations to assist with his field work. Samples of output of both textual and graphical information can be found following this annex and throughout the other working papers of this project.

CONCLUSION

The pilot project proved to be a productive exercise which facilitated:

* Development of a solid understanding of the user requirements of FRIS;
* Estimation of the storage and manpower requirements for the development of FRIS;
* Demonstration to SI personnel using real data and therefore producing realistic output; and
* Training of SI personnel in preparation for the Implementation Phase.


Notional Land
Boundaries
Mbola Land
558.5055
Na Ngali Land
1397.237
Komunisuki Land
1459.808
Surapau Land
2055.799
Longgu Land
2175.789
KM
0
1
2
3
4
5

Plot Number : 04-001-01-02 Desc : STRIP MAIN 20 X 100 (2)
Land Cover : FPM2 Party : 3 Date : / /
Cyclone : 0 Slope : 0

Species	Code	Diameter	Length	Form
MISC	61	30	0	0
MISC	61	30	0	0
SEMECARPUS	52	20	0	0

Plot Number : 04-001-01-03 Desc : CIRC 20 (1)
Land Cover : FPM2 Party : 3 Date : / /
Cyclone : 0 Slope : 0

Species	Code	Diameter	Length	Form
PLANCHONNEILA	62	80	12	2
VITEX	60	80	0	3
VITEX	60	100	0	3
POMETIA PINN	45	70	16	2
VITEX	60	140	0	3

Plot Number : 04-001-01-03 Desc : STRIP MAIN 20 X 100 (2)
Land Cover : FPM2 Party : 3 Date : / /
Cyclone : 0 Slope : 0

Species	Code	Diameter	Length	Form
MISC	61	20	0	0
MISC	61	20	0	0
MISC	61	20	0	0
MISC	61	20	0	0

Plot Number : 04-001-01-04 Desc : CIRC 20 (1)
Land Cover : FPM2 Party : 3 Date : / /
Cyclone : 0 Slope : 0

Species	Code	Diameter	Length	Form
VITEX	60	120	0	3
VITEX	60	90	0	3

Plot Number : 04-001-01-04 Desc : STRIP MAIN 20 X 100 (2)
Land Cover : FPM2 Party : 3 Date : / /
Cyclone : 0 Slope : 0

Species	Code	Diameter	Length	Form
MISC	61	30	0	0
MISC	61	20	0	0

ANNEX 6

PROVISIONAL WATERSHED CLASSIFICATION

Watersheds are useful planning tools. They have defined boundaries and are therefore easily recognised. At a simplistic level they represent a system with only one output point - the river mouth (if one ignores the groundwater system). In SI, a unit based on watersheds for general planning is a particularly useful tool because most rivers are important resources, both socially and economically.

Watersheds can be classified in various ways. The most common and accurate is based on crude volume budgets. However in this project the need is to define watersheds in terms of their:

- Internal robustness or stability
- External impacts if they are destabilised. (In SI this is essentially the effects on the coastal environment.)

Given below are a series of classes that one might expect to derive from a study of this type. The criteria limits are given only for purposes of discussion - they would have to be extensively refined during Implementation Phase of the project.

CLASS E - Exclusion Watersheds. These are defined as watersheds containing unique ecosystems whose integrity and preservation require their full protection and/or rehabilitation, they may be ranked by ecological criteria and may not require the whole watershed to be preserved. Mangrove areas are potential examples for which buffer exclusion zones might be defined which do not occupy the whole watershed. However these areas are not intended to be covered by the watershed classification unless the buffer zone is the whole watershed.

Two obvious subclasses would exist:

EE1
Watersheds with minimal anthropogenic impact at present and regarded as stable;

EE2
Watersheds with unacceptable anthropogenic impact and requiring intervention to stabilise. The project would not define these subclasses and would not propose intervention strategies.

Class D - Degraded Watersheds

These are defined as watersheds which irrespective of their anthropogenic use are regarded as unstable and should not be the focus of development. A wide range of subclasses may exist. A general list would include:

DW1
Watersheds undergoing high rates of erosion due to geological processes (also called baseline erosion) these would include the uplifted land forms, volcanic ash slips, bench topography and ravine lands of the tablelands. (These are common in PNG and probably in SI.) Essentially, they require permanent protection;

DW2
Watersheds undergoing excessive temporary destabilisation due to mass wasting processes related to cyclonic effects, these require medium term protection, and where necessary, land use planning policies, for the forestry and subsistence sector to reduce pressure on the resource;

DW3
Watersheds excessively destabilised by anthropogenic use and requiring interventionist policies for their rehabilitation.

Class S - Strategic Watersheds

These are defined as watersheds which are important to the water supply of urban and or village communities and the non agricultural and forestry industry sectors. Subclasses may include:

SW1
Watersheds with inland villages dependent on the watershed rivers for water supply or access;

SW2
Watersheds containing known or identified downstream sites for dams;

SW3
Watersheds providing urban water supplies;

SW4
Watersheds discharging into coastal currents of importance to the fisheries sector.

CLASS U - Utilisable Watersheds

These are defined as watersheds with identified agricultural (AOA) or forestry potential (from this project) for which it is technically feasible to expand these uses within the following guidelines.

UW1
Watersheds where slopes, soils and climate would permit extensive utilisation without generating excessive internal or external impact;

UW2
Watersheds where the identified resource is contiguous with unsuited areas, a suffix notation could be used to indicate the proportion and reason for "suitability" (for example UW2,4s would indicate that the watershed contains 40% of the area with slopes that are too steep for conventional logging.

CLASS O - Other Watersheds

Defined as all other stable watersheds requiring no intervention or specific protection and of no agricultural or forestry potential.

Quantifiable Classification Procedures

Quantitative Classification procedures rely on weighting the components of the watershed to arrive at a watershed stability index of some sort. Such a "smart" system uses the following logic. If the watershed contains x% of gross area with factor y, m% with factor n ....etc then classify it as .... The benefits with this approach are as follows:

It can be automated by simple programming
It can be updated if one or more of the factors is dynamic and thus changes with time (eg. agricultural land use).

The difficulties with the approach are as follows:

What is essentially subjective classification becomes regarded as scientifically based objective classification.

The rules for weighting are not known. For example what is the critical level of logging in a catchment type x before destabilisation occurs?

In the high rainfall tropics small area impacts due to clearing etc may have a major impact at the outlet end of the catchment. Even if we know the rules for weighting a particular factor the rule is scale dependent. This is less of problem in temperate catchments where processes are generally less variable in intensity in space and time.

Ultimately, a general classification based on simple static rules should be developed. These rules would be of the type "If the catchment contains active depositional land systems at its outlet and has important off and inshore environmental features, then it is considered a sensitive catchment as per the descriptive system." FRIS can be used to aggregate data to a watershed level to assist in this process.

The watershed classification should not be included in the data base until after the first major groups of Islands are completed and the project has a better understanding of the variables from the data base. In any case, inferences can be drawn from the land systems which would suffice in the short term. In the interim the project should attempt to conceptually clarify the preferred approach to watershed classification through discussions with the main departments involved in land use and forestry planning.

ANNEX 7

INCEPTION PHASE

SYSTEM DOCUMENTATION

INTRODUCTION

This Annex contains system information resulting from the system design and development undertaken by the Database specialist during the inception phase of SOLFRIP. The material presented in the annex is not intended as a full specification of the system but rather as a record of work undertaken. The annex also contains miscellaneous notes regarding ideas for additional items yet to be designed or coded. This annex should not be regarded as conclusive or final for all of the reasons above.

PROGRAMS WRITTEN

The table below shows the programs written thus far in the project :

FILE NAME		FUNCTION
SOLFRIS.PRG	Prog	Main menu system and report printing
CADAST2.PRG	Prog	Cadastral data edit
CAD_PROC.PRG	Prog	Procedure file for cadastral input
FBOOK.PRG	Prog	FFS field book data entry
FBO_PROC.PRG	Prog	Procedure file for field book entry
LAND_COV.PRG	Prog	Land Cover types lookup maintenance
LAN_PROC.PRG	Prog	Procedure file for Land Cover types
PTYPE.PRG	Prog	Sample plot type maintenance
PTY_PROC.PRG	Prog	Procedure file for Plot types
SPECIES.PRG	Prog	Forest Species lookup maintenance
SPE_PROC.PRG	Prog	Procedure file for Species maintenance
FBOOK.FRX	Rep	Field book data report
LAND_COV.FRX	Rep	Land Cover types listing
PARCELS.FRX	Rep	Cadastral data report
PTYPE.FRX	Rep	Plot types listing
SPECIES.FRX	Rep	Species listing
SOLCAD.PAS	Srce	Translation of cadastral data to MBI
SOLCAD.EXE	Exe	Executable of above
SOLGRID.PAS	Srce	TM to Geoid transformation Solomons
SOLGRID.TPU	TPU	Unit as above

Table 1 - FRIS Programs

Notes :

1. The SOLCAD pascal/executable program is called by CADAST2.PRG to translate the DBASE format files to MAPINFO MBI files directly.
2. SOLGRID is a modified version of the AMG to GEO translator belonging to ERSIS - maximum error approximately 0.3 metres.
3. SOLFRIS.PRG shells out to DOS to call MAPINFO using FOXSWAP to release sufficient memory.
4. All programs and source reside in the \SOLPROG directory of the drive on which the system is installed.

ORGANISATION OF DIRECTORIES

Directories are organised to group files according to the geographical unit which they represent. The following diagram summarises the placement of file categories.

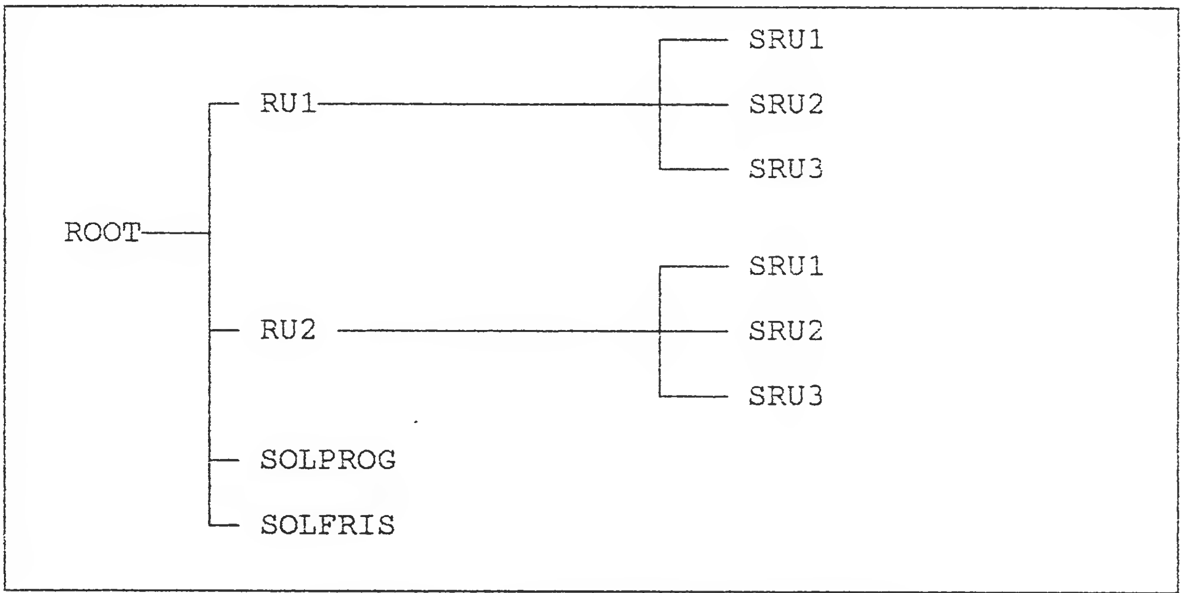


Figure 1 - Directory Structure

Notes :

1. No files will be stored in the Root directory
2. RU directories may be called by their names ie. GUAD, ISA etc.
3. The SRU directories will be called SRU1 ... SRUn as shown.
4. SOLFRIS will contain all national level data including lookup tables and cadastral boundaries.
5. RU directories will contain all data relating to the RU including slope boundaries, land system boundaries, coastline, rivers, ward boundaries, 400m contour, FRU database and FFS and EEFS data for the RU.
6. SRU directories will contain data relating to the SRU and temporary data entry files (which are later posted to the RU level database when completed). Files include temporary plot and tree files, temporary FRU files and FRU boundary files (permanent).
7. SOLPROG contains all program files. Contains source files on the development system.
8. The development machine will also carry a directory called SFOR_DOC. This is the documentation directory for the system and contains STRUCT.DBF, the database structure file and DBASES.DBF the database file list. These files should be maintained to reflect the current structure of the database. The report of the following section was printed from this data.

DATABASE STRUCTURE

The preliminary FRIS attribute database is shown in table 2 which follows.

File Name : FRU.DBF Description : Forest Resource Unit File
Comment :

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
LAND_COV	C	1	0	Entered by Digitiser while digitising API derived FRU boundaries - Will be checked by lookup in the Land Cover Type lookup database	API	LAND_COV -> CODE	Post
AREA	N	6	0	Area in Hectares derived automatically from MapInfo	FRIS	None	Not Required
PROVINCE	C	15	0	Derived automatically from Province Boundaries in the FRIS	FRIS	None	Not Required
ISLAND	C	15	0	Derived from Island Boundaries digitised in the FRIS	FRIS	None	Not Required
FRU	C	11	0	Unique number gererated by the system for each FRU - allows other files to relate to the FRU from within the database system. Note that this is unique within SRU ie the full FRU description is Regional Unit-Subregional Unit-FRU_NO	FRIS	None	Not Required
DOM_LS	C	20	0	Hansell and Walls land system Boundaries will be used to update this field - This will be updated as the dominant land system in the FRU	FRIS	LAND_SYS -> NAME	Look Up
AOA	C	15	0	Derived from AOA boundaries digitised into the FRIS	FRIS	None	Not Required
WATERSHED	C	15	0	Aggregations of H and W watersheds - this is the name. Derived from digitised boundaries	FRIS	WATERSH -> NAME	Look Up
SLOPE	N	3	0	From manual slope analysis of 1:50000 topographic sheets	OTM	None	Range Check
PARCEL	C	11	0	Alienated parcel in which the	FRIS	None (Yet)	Not required

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
				majority of the FRU falls (if any) ie no entry means totally customary			
LONG	N	10	0	Longitude of the FRU centroid	API/FRIS	None	Not Required
LAT	N	10	0	Latitude of FRU Centroid	API/FRIS	None	Not Required

File Name : LAND_COV.DBF Description : Land Cover Type Look Up Table

Comment :

Contains land cover type code to enable verification of the code where it is entered elsewhere in the system.

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
CODE	C	4	0	This is the four character Land Cover type code referred to in FRU.DBF and PLOT.DBF	API	None	No Duplicates
LAND_COV	C	20	0	Land cover Forest, Degraded etc	FD	None	None
COV_TYPE	C	40	0	Fresh Water Swamp Etc	FD	None	None
SPECIES	C	30	0	Dominant Species or species mix	FD	None	None
CANOPY	C	8	0	Canopy Density	API	None	None
MERCH	L	1	0	Merchantable True or False	FD	None	None
NOTES	M	0	0	Memo area to allow entry of notes for each forest type	FD	None	None

File Name : LAND_DES.DBF Description : LAND FORM DESCRIPTIONS

Comment :

Look up file to store land form codes and descriptions for L.S. as per Chase and H & W

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
CODE	C	4	0	Four Character Land Description Code - Related to By LAND_SYS file	Chase /HW	None	None
DESC	M	0	0	Free form description	Chase/HW	None	None

File Name : LAND_SYS.DBF Description : LAND SYSTEMS FILE

Comment :

Matrix to allow relationships between land systems and land form descriptions

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
NAME	C	20	0	Land System Name by H and W. Related to from the FRU file	H and W	None	None

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
DESC1	C	4	0	The first of ten descriptive attributes for the land System - Full description in LAND_DES file	H and W	LAND_DES -> CODE	Look Up
DESC2	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC3	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC4	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC5	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC6	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC7	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC8	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC9	C	4	0		H and W	LAND_DES -> CODE	Look Up
DESC10	C	4	0		H and W	LAND_DES -> CODE	Look Up

File Name : PLOT.DBF Description : SAMPLE PLOT FILE

Comment :

Stores data relating to sample plots including their positions

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
PLOT	C	12	0	Unique Plot Number for this Plot. Note that the full description is made up of Regional Unit-Sub regional unit-Strip Number - Plot Number. Also note that plot is not unique - the type is also required to identify any given plot	Field Book	None	Range/Format
TYPE	C	1	0	Coded allowable plot types - note that the full description of a plot requires type as PLOT is not unique	Field Book	PTYPE -> TYPE	Look Up
DATE	D	8	0	Date of Survey - Input once for each day but stored against each plot	Field Book	None	Range Check
PARTY	N	2	0	Field party number	Field Book	None	Range Check
UNIT	N	1	0	Don't Know what this is??	Field Book	None	Range Check

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
LAND_COV	C	4	0	Land Cover Type from field observation	Field Book	LAND_COV -> CODE	Look Up
CYCLONE	N	2	0	Cyclone Damage 1 - 9, 10 is 9+	Field Book	None	Range Check
SLOPE	N	1	0	Coded for three classes < 15, 15 - 30, 30+	Field Book	None	Range Check
FRU	C	11	0	Unique internal code for each FRU generated - MapInfo used to generate here	API/FRIS	FRU -> FRU	Not Required
LONG	N	10	0	Longitude of sample plot centroid	API/Field	None	Visual
LAT	N	10	0	Latitude of Sample Plot Centroid	API/Field	None	Visual

File Name : PTYPE.DBF Description : PLOT TYPE LOOKUP FILE

Comment :

This file is used to verify entry of the sample plot types eg. C20 - circular 20 m.

TYPE	C	1	0	Sample Plot type code, allowed values 1 - 9	FD	None	Numeral Only
DESC	C	20	0	Description of plot type eg Circular 20m	FD	None	None
AREA	N	4	0	Area of the plot in square metres	FD	None	Range Check

File Name : SPECIES.DBF Description : Species Description File

Comment :

Look up validation of species codes and for storing other information relating to species.

CODE	N	3	0	Species code related to from TREE file	FD	None	Range Check
NAME	C	30	0	Species name	FD	None	None
MERCH	L	1	0	True/false flag for merchantability	FD	None	None
FORM	N	3	1	Average form factor for this species	FD	None	Range Check
CUSTOM	C	20	0	Customary uses for this species	FD	None	None

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
USES	C	20	0	Commercial uses for species	FC	None	None

File Name : SRU.DBF Description : Sub Regional Unit File
Comment :
Stores name, DOS path and status for each sub regional unit

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
SRU	C	6	0	Identifier of the SRU (eg 04-001)	FRIS	None	None
NAME	C	30	0	Name of the SRU	FRIS	None	None
DIRECTORY	C	30	0	DOS Path to SRU data	FRIS	None	None
RUDIR	C	30	0	Path to Regional Unit Directory	FRIS	None	None
POSTED	L	1	0	Flag to show whether SRU field data has been posted to the main files	FRIS	None	Not Required
DATE_POST	D	8	0	Date SRU data posted to main files	FRIS	None	Not Required

File Name : TREE.DBF Description : SAMPLED TREE FILE
Comment :
Tree samples from field books there will be one record here for each tree sampled

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
SPECIES	N	3	0	3 Digit numeric species code	Field Book	SPECIES -> CODE	Look Up
DIAMETER	N	3	0	Tree diameter in cm (possibly in classes)	Field Book	None	Range Check
LENGTH	N	2	0	Trunk Length	Field Book	None	Range Check
FORM	N	1	0	Form Class	Field Book	None	Range Check
PLOT	C	12	0	Plot Number - automatically input from Field book entry for all trees on that page, made up of Regional unit-SRU-STRIP-Plot_no	Field Book	PLOT -> PLOT + TYPE	Look up
TYPE	C	1	0	Plot Type	Field Book	PLOT -> PLOT + TYPE	RANGE

File Name : WATERSH.DBF Description : WaterShed File
Comment :
This file contains the name and classification code of each watershed. One record per watershed.

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
NAME	C	15	0	WaterShed Name as per	Digitising	None	None

Fieldname	Type	Length	Decimals	Comment	Source	Relates	Validation
				digitised watersheds - related to from within the FRU file			
CLASS	C	4	0	Watershed classification - May not be used until late in the project	RIC	WAT_CLASS -> CLASS Look up	
LONG	N	10	0	Longitude of watershed centroid	Digitising	None	Not required
LAT	N	10	0	Latitude of watershed centroid	Digitising	None	Not required

File Name : WAT_CLAS.DBF Description : Watershed Classification File
Comment :
Stores the description of each allowable class of watershed.

CLASS	C	4	0	WaterShed Class related to from the watershed file	RIC	None	None
DESC	M	0	0	Freeform description of watershed type	RIC	None	None

ANNEX 8

ACCRONYMS AND

GLOSSARY OF TERMS

ACCRONYMS AND GLOSSARY OF TERMS FOR THE FOREST RESOURCES INVENTORY SYSTEM

Term	MEANING
AIDAB	Australian International Development Assistance Bureau.
AOA	Agricultural opportunity area.
API	Air photo interpretation.
Attribute	Textual information which describes a map feature, for example, the population of a village is an attribute of the village.
AUD	Australian dollar (or $A).
Cadastral	Relating to the cadastre.
Cadastre	The system of land ownership and registration, property boundaries etc. In the Solomon Islands this term will usually refer to the alienated (surveyed and registered) land as opposed to customary land.
Data Layer	A discrete graphical component of a map and its related attributes, for example, villages, their positions, and their attribute data such as population and age distribution constitute one 'layer' of information in the FRIS.
Database	A systematised method for storing large quantities of data. The data is arranged such that any item is easy to find and use.
Digital Terrain Model	(DTM) A mathematical representation of the Earth's surface. The DTM uses spot heights to generate contours over large areas and slope and aspect for small sections of the terrain. Advanced DTM systems can calculate line-of-sight, water flows (hydrographic modelling), volumes (for cut and fill operations), and actual surface areas.
Digitising	The process of 'tracing' a map or diagram into a computer. The map is placed on a 'Digitising Table' and an operator then moves a puck or cursor along the lines forming the map. The computer reads the position of the cursor relative to the rest of the map and stores features as strings of coordinates.
ECD	Environment and Conservation Division
FAO	The Food and Agriculture Organisation of the United Nations.
FD	Forestry Division, MNR.
FRIS	Forest Resources Information System.
FRU	Forest Resource Unit.

Geocode	The process of allocating geographical coordinates to a feature on a map. This is achieved by referencing the feature to an existing feature on the map, for example, a church might be given the coordinates of the town in which it resides.
GIS	Geographic Information System - a (usually computerised) system for storage, retrieval and analysis of geographical data, including maps and attribute data.
Integrity Routines	(n) Programs incorporated into the FRIS to ensure that data entered into the FRIS is entered correctly. Examples of integrity checking include : checking that a number is between two outer limits, checking that an abbreviation or code exists in a lookup table or ensuring that duplicate data is not entered.
MAL	Ministry of Agriculture and Lands
MAPINFO	A low cost, GIS produced by MAPINFO Corp of the United States.
MNR	Ministry of Natural Resources.
MU	Mapping Unit, SCD, MAL.
NFRI	National Forest Resources Inventory.
PA 1,2,3	Priority Area 1,2,3.
Parse	To break apart into meaningful sections. If a sentence is parsed then the subject, object etc are identified. In FRIS some codes will be parsed to identify the meanings of the codes. This allows one single, simple code to contain more information.
Plotter	An output device used by the FRIS to produce paper plots.
POA	Plantation opportunity area.
Point	In FRIS a point is a single location (one coordinate pair, ie one latitude and longitude). The point will generally have attributes attached to it. For example, one village could be represented by one point.
Polygon	A many sided figure, used herein to describe the area enclosed by such a figure, for example, one province is stored in FRIS as one polygon.
Polygonisation	The process of creating polygons from a network of lines, the area enclosed by the lines is identified as a polygon and is thus capable of having an identity. For example, the lines which make up the border of a province can be polygonised to form the province polygon.
PSA	The pilot study area.
PU	Photogrammetry Unit, SCD, MAL.

Raster GIS — A computerised system which represents map features as a series of cells or points. Each point is given a value which represents the value of the variable being mapped at that point. Examples could include mapping of vegetation types where each cell represents a square of (say) 30 metres which has a uniform vegetation type within it.

Scanning — Procedure to input graphical data into a computer automatically. Scanners work in a similar fashion to a facsimile machine in that the translate the map into a series of dots. In the case of a fax machine this is then fed to another fax machine via a telephone line, in a similar manner the scanner sends the dots to the computer.

SCD — Survey and Cartography Division, MAL

SI — Solomon Islands.

SID — Solomon Is dollar (or $SI).

SIG — Government of the Solomon Islands.

SII — Satellite image interpretation.

SOLFRIP — Solomon Islands National Forest Resources Inventory Project.

Spatial — Relating to space, that is, anything which can be measured in the three distance dimensions, for example, length, width and height or latitude, longitude and height.

Thematic Map — Any map which is designed to convey information about a particular topic, for example, a map of villages with a different symbol on different sized villages is a thematic map. The theme in this case is village population.

Vector GIS — A system in which the features on the earth are represented by points or lines (vectors).

Verification Plots — Paper maps generated by the system to allow the operator(s) to check the validity of data entered into the system.

WP — Project working paper.